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NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, March 8, 1919.

GLADIOLUS PARTLY WHITE AND PARTLY RED

A chimera caused by a vegetative mutation in a gladiolus corm resulting in the production of red, white and partly red and white flowers on a stalk of normally white flowering variety. (Courtesy of Prof. E. B. Babcock.) (Frontispiece.)

CHIMERAS IN CORN HYBRIDS

Xenia in F_1 Corn Hybrids Changed Through Mutation—Chimeras in Flowers—A Case of Chimera in a Fig

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AMONG the purple starchy F_1 dent grains of corn resulting from crossing Extra Early Adams white dent corn with Black Mexican sweet corn one grain was found half of which was white, the other half being the dark purple color characteristic of the male parent (Fig. 1a). The line separating the colored from the uncolored area was sharply defined.

In order to determine whether there is any hereditary tendency for the formation of such "mosaics," this F_1 grain was planted, and the four ears shown in Fig. 2 were produced. They showed segregation into purple and white colors and starchy and sugary endosperm[1] characters in the following proportions: 408 purple starchy, 352 white starchy, 172 purple sweet, 151 white sweet. This approximates the F_2 dihybrid ratio to be expected from a cross of white dent with purple sweet corn when starchy endosperm and purple aleurone[2] are dominant characters.

Among the 1,083 F_2 grains twelve were found showing reappearance of the mosaic in a degree as great or less than was shown by the F_1 parent. There is not sufficient evidence in the way of reappearances, however, to lead one to believe that the condition is inherited in a Mendelian fashion. East and Hayes grew a number of such seeds to see whether the tendency was inherited, but without positive results.

Similar cases in F_1 corn hybrids have been noted by Correns and by Webber, both of whom believed that it was caused by the failure of the second pollen nucleus and the endosperm nucleus to fuse, so that each nucleus developed independently and thus formed one-half of the endosperm, which is enclosed by the colorless pericarp composed entirely of maternal tissue. This explanation cannot hold in this case, because, if such were true, the purple half of the seed should also have had the sweet endosperm, inasmuch as the factor for purple aleurone and the factor for sweet endosperm were carried by the same (male) nucleus. Reference to Fig. 1a shows that the entire grain had the starchy endosperm. The F_2 results show the embryo to have been a true hybrid for both aleurone color and endosperm texture, with the starchy endosperm, to all appearances, completely dominant in the F_1. If we are to believe that each nucleus developed independently to produce the bicolored aleurone effect, how can we harmonize this belief with the fact of uniform dominance of the starchy endosperm? East and Hayes suggest that the phenomenon may be due to "Mendelian segregation" in somatic tissue. That there is no known physical basis for the operation of such segregation is clearly shown by Babcock and Lloyd where they state that "the mechanism by which this (Mendelian) segregation is accomplished is the separation of whole chromosomes in the heterotypic mitosis (meiosis) during maturation of the *germ cells*."[3] Such separation of chromosomes does not normally occur during division of somatic cells.

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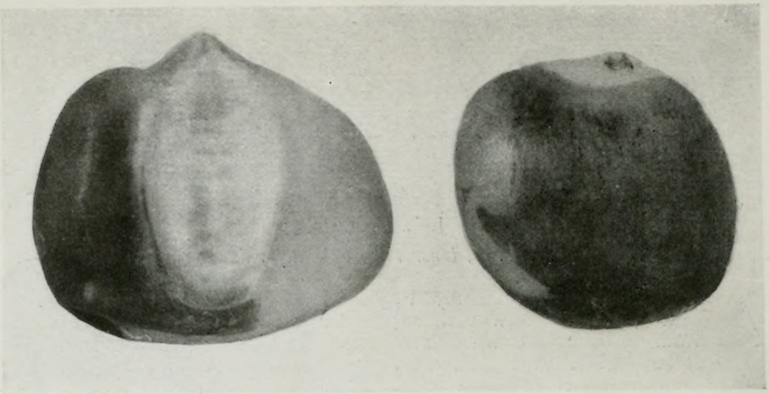
[1] Endosperm.—The substance stored in a seed adjacent to the embryo, for its early nourishment.

[2] Aleurone.—The protein granules found in the endosperm of ripe seeds.

[3] Italics are mine.

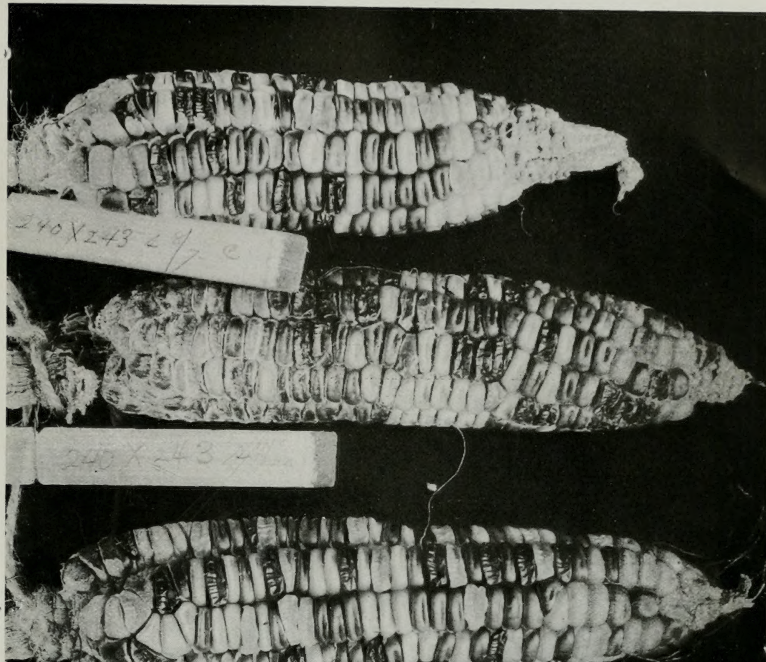


A PECULIAR GRAIN OF CORN

A chimera in a grain of corn caused by the occurrence of a factor mutation in a single cell at an early stage of aleurone development. Colors purple and white. (Fig. 1a.)
A chimera involving a smaller area of changed aleurone tissue. Colors purple and yellow. (Fig. 1b, at right.)

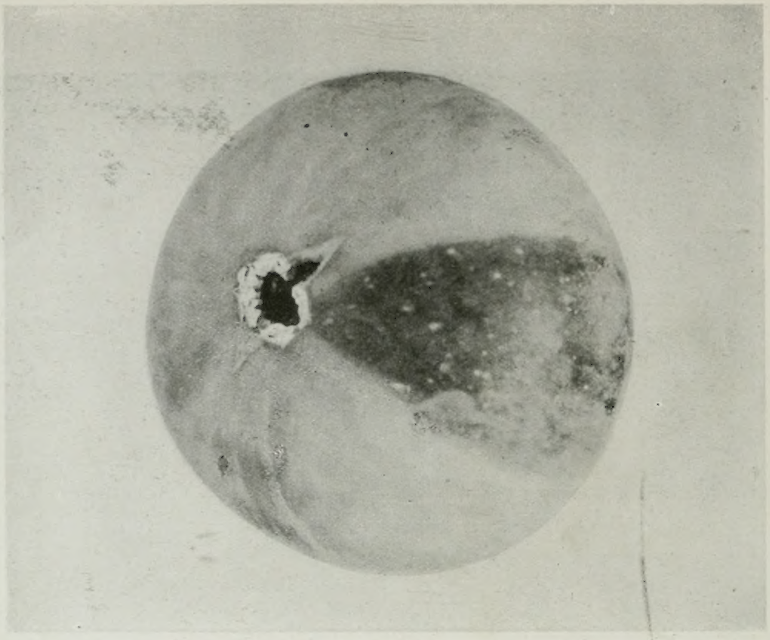
A more probable explanation of this two-color phenomenon in corn is the occurrence of a vegetative factor mutation in meristematic tissue causing the development of a chimera. The result could be produced by the occurrence of a mutation affecting the aleurone color factor in one of the cells at a very early stage of the development and growth of the zygote, such that all cells descending from the mutated cell would have the white aleurone layer. The application of the mutation idea adequately accounts for the occurrence of areas or stripes of white, which are less than one-half of the surface of the grain, as in Fig. 1b. Some of the F_2 grains from the one shown in Fig. 1a had only a small spot of white aleurone, which was surrounded by purple. These white cells may be considered as the outgrowth of a single cell in which mutation occurred in the color factor much later in the development of the aleurone layer than was the case where approximately one-half of the grain was white. The appearance of these smaller areas cannot be adequately accounted for by the theory of the independent development of the second pollen nucleus and of the endosperm nucleus, even when the additional evidence from endosperm texture is not considered.

If objection is raised to the application of the mutation hypothesis here because of the appearance of a number of similar mutated individuals in the same or the immediately succeeding generation, attention only need be called to similar cases in other plants where this sort of phenomenon reoccurs many times, and has been explained as due to mutation in vegetative tissue. Perhaps the best known case is that of citrous fruits containing one or more sections differing in color or texture from the remainder of the fruit. Babcock and Clausen attribute the appearance of partly red and partly white colored gladiolus flowers on a plant of the white variety known as "The Bride" (Frontispiece) to a factor mutation in meristematic tissue. Their account of its appearance is as follows: "In 1915 there appeared in a row of 'The Bride' a single stalk bearing partly red and partly white flowers. That this grew from a corm which was an offshoot from a typical white flowering corm is certain. Furthermore, that the mutation occurred very early in the development of this corm and not some time during the growth of the flower stalk



CORN GROWN FROM A GRAIN CHIMERA

Four F_2 ears of corn produced by selfing the F_2 plant grown from the grain chimera shown in Fig. 1a. (Fig. 2.)



A COLOR CHIMERA IN A FIG

The cell in which the change took place was not in the developing young fruit, but in a cell of the young shoot on which the fruit grew. (Photo by courtesy of Professor I. J. Condit.) (Fig. 3.)

is proved by the following observations: In the autumn following the discovery of the mutant stalk it was carefully lifted and the corm from which it grew was separated from the cluster of white flowering corms. It was observed that there were smaller corms located very close to the mutant corm. The following spring one flower stalk bore red and white and the other only red flowers. In gladiolus the young corms push out from near the base of the old one. Hence the original mutant corm must have consisted partly of cells capable of producing red pigment in the flowers. That the cells having this altered chemical constitution comprised about one-half of the corm is indicated by the position of the red and white flowers on the stalk." A like condition in the canna lily is shown in Fig. 5, where the change envolves foliage leaves, flowering stalk and flowers.

Similar kinds of vegetative mutations in fruits, causing the appearance of sharply defined color and texture areas, have been reported in apples, peaches, cherries, prunes,[4] tomatoes,[5] olives and figs.[6]

The fig-chimera here reported (see Fig. 3) appears to be of a slightly different type of origin from the other chimeras mentioned, and also from the corn grains under discussion, in that the cell in which the change took place was not in the developing of young fruit itself, but in a cell of the young shoot on which the fruit grew. A few

[4] J. C. Whitten, Division of Pomology, University of California.
[5] E. B. Babcock, Division of Genetics, University of California.
[6] I. J. Condit, Division of Citriculture, University of California.

PARTLY WHITE LEAVES FROM A FIG TREE

Leaf chimera from the tree which produced the fig shown in Fig. 3. Notice the chimera condition in the branch. (Photograph by courtesy of Professor I. J. Condit.) (Fig. 4.)

CHIMERAS IN GRAINS OF MAIZE.

Three grains of maize showing chimeras in which the endosperm characters sugary and starchy are involved. (Fig. 5a, b, c.)
A color chimera in an F2 grain of sweet maize. (Fig. 5d.)

of the leaves growing on the tree which produced the fig-chimera were characterized by white areas or sections, as shown in Fig. 4. Many examples of this kind of chimera have been demonstrated. Norton was able to trace a foliage color difference down the stalk as a different colored stripe in a whole branch of a tomato plant, narrowing until its origin was apparently located in a single cell. Buds pushing out at the point of union between the stripe and the normal colored portion of the stem bore two-colored leaves similar to the fig leaf in Fig. 4.

If we use the mutation hypothesis to account for a change in color in a portion of a corn grain, it would appear reasonable to expect that mutations might occur in factors affecting other chemical constituents of the endosperm. Grains of corn showing such changes in endosperm have been found[7] (Fig. 5a, b, c) among the hybrid progeny of two other different strains. The cross between the varieties Country Gentleman (sweet) with U. S. White Dent (starchy) produced among the F_2 progeny seven grains with sweet patches in the starchy endosperm (Fig. 5a,b,c).

Among the F_2 grains derived from the one shown in Fig. 1a, a half purple and half white sweet grain was found, to which a great deal of interest is attached, because in this grain lies the possibility of our being furnished with the proof that the mutation hypothesis here given is the correct one. If the progeny from this grain (Fig. 5d) gives evidence that the embryo is homozygous for the purple color, then the change from purple to white in the aleurone can only have come about by somatic mutation in the manner herein de-

[7] Furnished by Dr. R. E. Clausen.

CHIMERA IN A CANNA LILY

A canna lily of the purple or bronze leaved red flowering variety in which a change took place apparently in a cell or cells of the root at the point where the bud pushed out, causing the chimera in the stem, leaves and flowers. Areas of the bronze leaves changed to pure green and flower color changed from red to yellow. The open flower on the left side of the stalk is half red and half yellow. (Photograph by courtesy of Professor W. J. Pope, University Farm, Davis, Calif.) (Fig. 6.)

scribed, while on the other hand, if evidence is furnished that this F_2 grain is heterozygous for purple and for nonpurple (white), no violence will be done to our mutation conception of the origin of the chimera.

SUMMARY

Grains of hybrid corn are here reported in which xenia occurs only in a portion of the aleurone layer, others having sweet patches in the starchy endosperm. Evidence is furnished disproving the theory of independent development of the second pollen tube nucleus and the endosperm nucleus. A factor mutation occurring in a single somatic cell, producing a chimera, is offered as the more probable explanation of the phenomenon. A certain F_2 grain may furnish conclusive proof of the hypothesis advanced. Instances are cited of the occurrence of similar chimeras in several plant genera.

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The Effect of Cross-Pollination on Size, Color, Shape and Quality of the Apple[1]

W. H. Wicks, formerly horticulturist, University of Arkansas, reports the results of investigation for three years of the "Effect of Cross-Pollination on Size, Color, Shape, and Quality of the Apple." It is the second publication of a series on apple pollination problems begun at the Arkansas Experiment Station in April, 1914.

The necessity of cross-pollination of the apple has been set forth by investigators, both in this country and abroad. Considerable literature on this subject has accumulated. Data collected, also, by this station since 1914 show the necessity of cross-pollination. Growers are now aware of the importance of cross-pollination and are planting commercial apple orchards in alternate varieties. More bees are kept each year by the more progressive orchardists, as it has been demonstrated that insects, especially the honeybee, are most beneficial in promoting pollination.

Where this occurs the question arises, what is the immediate influence or effect of the pollen of the male parent on size, color, shape, and quality of the fruit of the female parent? This study was conducted during 1915, 1916, and 1917, in a typical commercial orchard at Springdale, Ark.

[1] Monthly Bulletin of the California State Commission of Horticulture, October, 1918.

BETTER AMERICAN FAMILIES

Heredity in Its Relation to Social Selection in the Formation of Distinctive American Strains

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HISTORIES have hitherto been written as though the genius of a nation were something mysterious, impersonal, which inheres in its constituent people, lifting them and their institutions to a zenith of power, and then as certainly bringing to them decadence and death. The life of a race has been conceived as unfolding itself in obedience to immutable law, which in the mere passage of time effects its extinction even as it effected at an earlier period of its development complete expression of its potentialities. So far as analogies from biology have been sought, we have said, in brief, "This people lives; hence it must, in due course of time, die." At the best, we assign as conceivable causes of national decline one or two outstanding facts. Thus Rome fell because of malaria or dissolute living, and Spain suffered fatal weakening through the emigration of her able men and the multiplication of her religious orders.

NATURE OF THE SOCIAL PROCESS

The facts of history take on new interpretations with the years. In the rewriting of history which the present world crisis has stimulated we witness an encouraging attempt to disentangle all the factors germane to this vital problem. In this effort the social psychologist has preceded the historian in seeking the essentials of the social process in the traits and tendencies of the individual, the influence of the environment on those traits and tendencies, and in the ideals and social standards he is led to establish. In particular are we taking account of the nation's dominating personalities, their nature and origin, the interplay of these personalities with the masses, as well as the response of the latter to the urge of ideals and traditions as represented in institutions; for institutions are nothing more than the enduring expression of the dominating personalities of the past.

From time to time in the life of a people danger signals are flung out and impassionate voices give warning of the doom that is certain to overtake persistent indulgence in national sins. From its earliest beginnings America has listened to many such jeremiads, though of late these prophets of impending dissolution have been overborne by the chorus of self-gratulation following young America's part in deciding the world conflict. Our irresistible man-power, with the spiritual reënforcement which it brought to the winning of the Great Cause, gives grounds to many for belief in the essential soundness of our national tissue, while to the less assured the war is viewed as furnishing the stimulus which shall speedily evoke new and unexpected virtue in the body politic. So, at the beginning of the Crimean War, sang Tennyson of the moral regeneration to be wrought in decadent Britain. Between these two extremes lies the middle ground of earnest questioning as to what is fundamental in the genesis and development of national tendency. What, in essence, is that process of "Americanization" which, in the space of a few centuries, has gone far to transform a heterogeneous mob of immigrants into a nation with its present rôle in world politics?

We have thus a new starting point in our interpretation of American history. That this study has for us far more than a merely academic interest is made clear by the following considerations. Whatever the present crisis may compass in bringing latent possibilities into fullest play through the stress of untoward conditions, and however it may make for national revitalization, we may not look to it to change directly the basic fabric of our society. Such change can come only through the heightening of social consciousness and the influence of this heightening on the social policies of the future.

THE DIRECTION OF THE SOCIAL PROCESS

The socio-psychic process which we know as education and, in its boarder sense, as culture, implies in the first instance efficient leadership, and efficient leadership implies balance between means and method, and susceptibility to response on the part of those who are led. In our determination of social policies it is fortunately not necessary to choose between refinement of means and methods for the development of human possibilities on the one hand, and, on the other, the increased susceptibility to response which shall give their fullest effect to these educational means. It is, however, of the highest importance that the refinements of means and method do not carry with them as sequelae a decreased susceptibility to response through deterioration in the native capacity of the individual.

It is here that we reach the heart of our problem. For deeper than the problem of educational method lies the problem of physical and mental fitness. This can be met only by care for the innate character and aptitudes of the stocks from which chiefly the elements of our population come. The phenomenal history of America is the history not only of the regnant families who formed her ideals, giving them expression in her traditions and institutions. To a far greater degree it is the history of her lesser families, drawn from some of the soundest stocks of many nationalities, hence attracted by all that America has come to stand for, and following successfully where the greater individualities led. Aristogenesis concerns itself with the origin of superior endowment, whether in individuals of superlative worth or in the mass of our citizenry who maintain successfully the standards set by persons of superlative worth. The present paper aims at a fruitful line of inquiry into the relation between aristogenesis and the social process.

SOCIAL SELECTION IN COLONIAL TIMES

It requires no careful reading of the annals of the early settlers to discount assumptions as to their universal saintliness. Came convict hordes and shiploads of adventurers; yet it cannot be denied that the majority were from the sturdy gentry and moved mainly by a desire to improve their worldly condition by honest means, with a strong leavening, particularly in New England, of those devoted to spiritual ideals. This population was subjected to a physical and social selection the nature of which can be but briefly indicated. Added to the elimination of the weak, which the shocking conditions of ocean travel entailed at that day, came the rigors of the New England winter and farther south the ravages of the malarial mosquito. In addition to this, the colonists were in constant danger of attack by the Indians. Hear the historian of Long Island: "Although the land was honorably purchased from the aboriginal owners, yet the settlers never saw a moment's rest, for fear of their dreaded neighbors. In the field a guard was kept; at night none knew at what hour the alarm would sound; to meeting on the Lord's Day they went as men prepared for instant war; every male from sixteen to sixty was a soldier enrolled in the ranks; and in proportion to its population the town could boast a larger standing army than any nation on the face of the globe." So much for the array of tests which weeded out the unfit—tests so rigid that the easy adventurer preferred to fare otherwise, and many a faint-hearted jail-bird prayed to be sent to the gal-

lows instead; but for those rich in courage, wit and hardihood, this world of new and extreme conditions furnished the supreme opportunity for dominance and the handing on of these hardy virtues to succeeding generations. Then, too, to the man who had been persecuted for his religious belief or outlawed because of revolutionary doctrines, came the opportunity, in the absence of powerful central organizations, to assert his beliefs and secure a following. Every settler was thus a peer of the realm, and as such a potential aspirant for any honor or office of the realm. The effect of this combination of factors in sifting out the able and worthy of whatever station, giving them preëminence and through this preëminence bringing about alliances which produced the quality of the regnant colonial families, cannot be overestimated.

IN THE OLD NORTHWEST

Nor are we to imagine that there has been serious limitation of this process in the conquering march of settlement westward. The early immigration to Massachusetts Bay was from the most virile stocks of Devon and Somerset. These stocks furnished the seed of self-governing New England and founded the institutions which should put the democratic ideal before every migrant to our shores. As we trace these families westward, we find their representatives leading in the establishment of social institutions, and often because of greater vigor and aggressiveness, making a short cut in social and economic effectiveness. It is a significant fact that the small state of Massachusetts furnished 115,000 men to the Civil War, but far more significant is the fact that in the quota of enlisted men furnished by a western town in the present war 23 nationalities should have been represented, each vying with every other in its resolution to defend to the last ditch the American ideal. In other words, we have had in the immigrant of yesterday a responsive sensitiveness to the social and emotional traditions for which the word "America" has come to stand. These traditions served largely to select the dominant tendencies of the immigrant and the strain from which he sprang, and these tendencies have in their turn been preserved and oftentimes intensified through union with similar strains which earlier found a home here. Running parallel with the genetic process is the educational process and all that we include under the term "social heritage." This, as already indicated, is in essence as follows: The raw contacts, with the realities of frontier existence and all that went with the phenomenal development of our virgin resources, developed resourcefulness and initiative, while the social institutions founded by our leaders, offshoots in the main from the early ablest American strains, clarified, defined and further strengthened inchoate strivings toward the American ideal.

The lesson of the persistence of defect through successive generations has been brought home to us in such histories as those of the "Jukes," the "Ishmaelites" and the "Kallikaks." Of equal significance is the study of families where, by fortunate matings, trait combinations spelling superior endowment have been effected. The story of such families will be taken up in succeeding papers.

Meet Success in Producing Seed of Sugar Beets in This Country

To reduce dependence on foreign sugar-beet seed, efforts to produce this seed in this country are meeting with distinct success. Before the war domestic production was almost at zero. In 1916 the production had risen to 5,211,000 pounds, in 1917 to 5,558,000 pounds, and in 1918 to 6,384,000 pounds, the estimate for the last year being subject to revision.

Along with this movement, the acreage planted to sugar-beets has greatly increased.—*Weekly News Letter, U. S. Dept. of Agriculture.*

NEW EVERBEARING STRAWBERRIES

W. Van Fleet

Bureau of Plant Industry, United States Department of Agriculture

SEVERAL varieties of strawberries that continue under favorable conditions to fruit throughout the summer and autumn after bearing a fair spring crop of berries have lately come into favor. All are descendants of the Pan American, a sport or mutation of the Bismack, a former commercial variety of the *Fragaria virginiana* type in which the runners are to a great extent suppressed, favoring the successional production of fruiting crowns during the growing season. This peculiarity appears heritable in many seedlings and hybrids of Pan American, and the horticultural section thus established has been given the convenient but somewhat misleading name of "everbearing," as special cultural requirements in the way of moisture and fertilization are needed to insure fruit formation and plant increase during the most exacting summer months. Progressive and Superb are the most popular varieties of the new type and are increasingly planted. They leave something to be desired in productiveness and plant-making capacity, as few runners are thrown out from the more prolific plants. Seedlings continue to be grown from the present everbearing varieties, and crossings have been made by several growers with spring-fruiting commercial varieties and varieties of the European Alpine strawberry *Fragaria vesca,* which naturally fruits over a long season, in the hope of developing features of additional value. *Fragaria vesca* in the European and Mexican Alpine forms has rarely proved worth cultivating in North America, as the plants do not well endure our hot sunlight and the berries, though well flavored, are small and soft in texture.

While traveling in Chile as an agricultural explorer in 1914, Prof. W. F. Wight, of the Bureau of Plant Industry, forwarded seeds of a fairly large-fruited Alpine strawberry occasionally sold in the Santiago markets. The type is that of *Fragaria vesca,* but whether native or introduced could not be ascertained. When grown in the introduction gardens at Rockville, Md., and Chico, Cal., of the Office of Foreign Seed and Plant Introduction, certain of the resulting plants showed greater vigor, fruitfulness and general adaptation to our climatic conditions than any Alpine hitherto introduced. They have endured our hot, dry summers, fruiting continuously from June until frost under the most ordinary cultural treatment, at the same time throwing out an abundance of strong runners. The berries are well flavored, but lack firm texture and sufficient size to be of practical value. Plants have been disseminated in a limited way for further trial under the introduction number of 35005. The ability of this South American strawberry to fruit and produce runners simultaneously throughout the summer and autumn suggested the possibility of developing large-fruited varieties holding the same characteristics by hybridizing it with practical commercial spring-bearing sorts. Chesapeake and Early Jersey Giant were selected for the purpose as being well adapted to local conditions at Bell Experiment Plot, Glendale, Md. Pollinations were carefully made under glass in February, 1916, and the resulting seedlings grown in the field. About 400 fruited in June, 1917, showing high average merit as June-fruiting varieties, but with no obvious tendency toward continuous bearing.

Runners from two of the best plants were rooted in pots during summer,

A NEW "EVERBEARING" STRAWBERRY

This variety of strawberry continue sunder favorable conditions to fruit throughout the summer and autumn after bearing a crop in the spring. It is the result of a cross between *Fragaria chiloensis* and *F. vesca*. Photographed by Crandall. (Fig. 7.)

A NEW "EVERBEARING" STRAWBERRY

Another view of the new cross produced at Bell Experiment Plot, Glendale, Md. Photographed by Crandall. (Fig. 8.)

brought into bloom under glass early in 1917, and again pollinated with No. 33005, something over 150 seedlings resulting, four of which bore handsome, large berries continuously from July until November the past season, producing a good supply of vigorous runners at the same time. The plants shown in the illustration were photographed September 26 and continued to ripen fruit for several weeks. In appearance, size and quality the berries most favorably compare with the best of the everbearing varieties now in cultivation, while the plant-making propensities rival those of the commercial spring-fruiting kinds. If, as now appears probable, superior continuous-bearing strawberries with free runner production can be developed by the use of an Alpine variety adapted to the American climate, there will be little need to depend on the progeny of the mutant Pan American, with its inherent tendency toward slow plant increase.

TESTING NEW FOODS[1]

DAVID FAIRCHILD

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EVERYONE has his own idea of foods and will discuss it with you as long as you will listen. It forms the chief topic of conversation among primitive peoples, and yet, strange to say, so little serious attention has been given to the subject that the real bearing of taste upon food production is not suspected by most educated people.

There is a general feeling that a new food plant comes into use in some quiet, mysterious way, that belongs in the category of natural occurrences, instead of requiring the solution of many practical problems.

In the attempts which my associates and I have been making for twenty years to introduce into use in America the food plants popular in other lands, we have learned a good many things about foods and the difficulties of really testing them, and we have also caught a glimpse of certain changes which are coming in the world of food production and consumption. The thought that these experiences of ours and the deductions which we have drawn from them may interest the members of this section of the association, prompted me to accept Dr. Cook's invitation to join such distinguished company as that of my old friends Harper and Moore.

It is a complicated thing to test a new food plant; it seems simple, but it is not so. Let me give some actual experiences in illustration.

THE ARRACACHA

In 1899 I visited Caracas with my friend Mr. Barbour Lathrop and became familiar with the Arracacha, (*Arracacha xanthoriza*), *which is a* favorite vegetable among Venezuelans. I ate it poorly prepared in a hotel there, but believed, nevertheless, that it had possibilities. My friend was rather indifferent to it. I interviewed old Dr. Ernst, a German botanist, who had spent many years in Caracas, and he was enthusiastic in his praise of it. How could it be decided whether my friend's epicurean judgment, Dr. Ernst's, or my own, in regard to the vegetable, was correct? I decided that my own guess was as good as my friend's, and that when the vegetable was better prepared, and he again had a chance to taste it, he might change his mind. There were no other Americans in Caracas whose opinions I could get. The vegetable could not be sent to the United States, for it would rot on the way. The only alternative was to get sets[2] of it and grow them in some part of the United States. I had not seen the plant growing, so I went into the interior and saw it as it is grown there in the door-yards, and photographed it under difficulties. The sets failed to survive the voyage. I imported them again in 1899 from Jamaica, in 1905 from Porto Rico, in 1909 from Panama, in 1910 again from Caracas, in 1911 from Panama and Caracas, again in 1912 and 1913 from Caracas, and in 1916 from Jamaica and Venezuela. Sometimes they died in transit, sometimes they refused to grow after being injured by the necessary fumigation, and sometimes they were killed by neglect or frost in the field tests. At last Consul Brett of La Guaira sent me a lot of fine sprouts or sets, and, coinci-

[1] Address before the Botanical Society of America and Section G of the American Association for the Advancement of Science, in Baltimore, December 26, 1918.

[2] Young plants fit for setting out.—ED.

A TABLEFUL OF NEW FRUITS AND VEGETABLES

These were all gathered at one time at the Plant Introduction Field Station at Brooksville, Florida, and represent samples from the somewhat extensive trial plantings there. They were gathered for culinary tests. Reading from left to right their native names, common enough in the countries from which they come, are Cassava, Dasheen, Yautia, Yautia leaves, Paitsai, Tamopan Persimmon, Soy Beans, Bermuda Arrow-root, Edible Canna, Water-Chestnut, Chayote, Roselle, Arracacha and Botor. (Fig. 9.)

dent with their arrival in America, Mr. Morrow, a very unusual plant propagator, was stationed at our introduction garden in West Florida. The imported plants were potted and grew and were sent to Mr. Morrow, and last year he forwarded to Washington a root of the Arracacha which, because it was the only one, and a curiosity, never got into the soup. It was only a few weeks ago, after twenty years of waiting, that I had the pleasure of digging, cooking and eating, under the circumstances of American life, the Venezuelan Arracacha, and of demonstrating to the satisfaction of a number of Americans that it is a desirable vegetable. Ernst declares it is superior to the best potato. Barrett says it always sells for a good price in Porto Rico. Schultz says it resembles a cross between potato, celery and asparagus and is roasted, fried or baked in Panama. Lara says it furnishes a nutritious flour used for invalids in Venezuela. Masters says its flavor is intermediate between a chestnut and a parsnip. How desirable the Arracacha is in comparison with other vegetables will require years of patient work to determine, for first of all we must find out whether the variety we have is the best there is when grown in America, whether the characteristics of season, hardiness, productivity, keeping qualities and shipping quality will give sufficient advantage over other vegetables with which it comes into comparison to make it remain in our gardens. Into the problem now will enter such questions as the following: Who is it that says the vegetable is good to eat? Has he good taste in vegetables? Where does the matter of learning to like a new flavor or texture come into the question? What influence has the manner of preparation of the vegetable on its palatability? Has it a character which will make people crave it, or will they be indifferent to it, confusing it with something else? Then there are the long "waits between drinks," so to speak; periods between the seasons during which one cannot have the vegetable to taste—in most cases nine or ten months. But these are only the beginnings of the difficulties, for there is another whole set of them.

To test a new food plant with the object of getting your countrymen to take up its culture means, as I have said, that you must get the best of its kind. But how can this be done? If you take the opinion of the foreign people who grow the various varieties, how do you know their taste is like that of the American in the matter of foods? The Chinese do not like soft berry fruits, such as raspberries, and prefer to eat their stone fruits while still hard; they eat their rice without salt; they do not like butter nor milk, because it smells too strongly of the cow; they are not, as we are, absurdly fond of sweet candy (they find it too sweet); they cannot understand how we can bear the flavor of tomatoes, nor why we don't all like the flavor of their soy sauce instead of meat gravy. Evidently their opinion of the best variety of soy beans may not be ours, so the only thing to do is to collect all its varieties which can be secured and test them side by side. We brought into America over a thousand varieties of soy beans, and Mr. Morse, the soy bean expert of the Department of Agriculture, has selected perhaps a dozen or so of these beans which, in his opinion, are superior to the others in flavor or in some characters of earliness, productiveness, and usefulness for special purposes. Mr. Young, the dasheen expert of the department, grew over a hundred varieties of the taro before he found the Trinidad dasheen, the Pat Long Fu, the Yatsugashira, the White Sprout, and the Belembe—special varieties of a vegetable which is grown and eaten in one form or other by millions of people throughout the tropics. Mr. Hume has in his collection in Florida at least fifty varieties of the Kaki (the Japanese and the Chinese persimmon), but, I understand, that he is enthusiastic over only three or four. In the case of wild fruits which have not been selected by man, the problem is still further complicated, because the mistake is so universally made of condemning a species

A SINGLE SOY BEAN PLANT LOADED WITH PODS

This bean (*Soja max*), unlike any which Americans have grown, until quite recent years (except as a fodder plant for livestock) has been for many centuries one of the great food plants of China and Japan. There are many hundreds of varieties, some being grown for oil and others for the making of vegetable cheeses, and from others the great flavoring sauce "Soy" of the Chinese and Japanese is made. The use of this palatable, nutritious sauce might be justly compared with the use of gravies among occidentals. (Fig. 10.)

to oblivion without considering the fact that one has tasted only a rank, worthless seedling. I have tasted North American pawpaws (*Asimina triloba*) which are as deliciously flavored as the finest cultivated annona of Maderia, but most people have tried only the rank-flavored, worthless seedlings. As a result, our largest, finest native wild fruit has remained for four centuries practically untouched by the horticulturists of America. The watery, tasteless seedling avocados (foolishy called alligator pears) which a few years ago came into the markets of New York and Philadelphia from Columbia are not to be compared with the selected grafted varieties of Florida and California, and their sale is doubtless responsible for many people's dislike for or indifference to the most remarkable of all salad fruits. Many seedling mangos are so strong in turpentine that only one who has formed the habit of eating the mango really enjoys them. I once had the experience of changing completely the opinion of an American millionaire who had traveled hurriedly through India, the land of the mango, and who had formed a very unfavorable impression of that wonderful fruit, by tasting some poor turpentine variety, by giving him a delicious mango variety from grafted trees in Florida.

So it is necessary to bring in and grow all varieties possible in order to select the best for the American palate. But it is not enough to grow a single plant of a kind in botanic garden fashion. Practical experience has shown us that a test of a variety requires the production of many bushels of the fruit or vegetable. My friend, Mr. Lathrop, took me down the coast of East Africa purposely to get a special mango which he had eaten and liked. When it first fruited years later in Florida, it proved so disappointing in size and flavor as to arouse a good deal of ridicule. By accident, however, a number of trees were permitted to live and bore large crops of fruit, and they came to be appreciated highly by those who could get them. For years we tried to decide whether the various dasheens were really good vegetables by growing a each kind; but we dis the time we had tr dasheen in vario small gro opinion, t seas to g ture yea out the unde are keeping only point of view.

When I tasted for the first Chinese jujube, on a French stea off the coast of China, I liked it immensely and made up my mind that th Department of Agriculture should gc it, but when I mentioned the jujube to some of my colleagues of the department, I was taken to a worthless seedling growing in the department grounds and told that it had been tried but wasn't fit to eat. Only since we have planted an orchard of twenty odd distinct varieties of Chinese jujubes, and gathered hundreds of pounds of their fruit and candied them, have we been able to make an impression upon our audience and prove to many that the jujube rivals the date in delicacy of flavor.

The Paitsai, a Chinese species of mustard, has been grown in the gardens of the country for many years without much progress, but the production of 20,000 boxes of it recently and the rapid rise in popularity of the Cinese restaurants, where it is so largely used, are giving it a test of the proper proportions.

THE MANGO

But large quantities are necessary, not only to determine the best varieties, but also to enable one to find out whether many people will like a new thing or not. In the early days, when a single mango (the first of its kind to be produced) was sent in from one of our test gardens, I remember with what pride I took it to our then Secretary of Agriculture, and presented it to him. Neither shall I ever forget the disappointment when I learned that one smell of it was enough, that he gave

A FIELD OF SOY BEANS, THE GREAT CHINESE CROP, IN MARYLAND

The harvesting machine has been over the central rows and has beaten out the beans from the pods. Although the pr[illegible] machine harvesting of soy beans has not been solved with complete satisfaction, enough has been done otherwise to assur[illegible]nous crop becoming a most important one for cultivation in America. Its roots are covered with nodules of nitrog[illegible]gathering bacteria. The crop from this field will be used by the Department of Agriculture to stimulate the cultivation of the soy bean by farmers and its use as a food by householders. (Fig. 11.)

it to one of his friends, that this friend tried it on his family, who passed it on to the colored man that cut the grass; the colored man gave it to the chickens, and they all declined to like it—my precious and only mango, which I knew Englishmen in India would rave over! The experience was a crushing disappointment. I had taken the mango to the wrong market. It took me some time to realize that the man in authority over one is the very last man that one should prejudice against one's work by trying to get him to eat a new fruit. Had I been able to give the same variety of mango to scores of people and compare their opinions, I would have discovered that there are people everywhere who will, as well as some who will not, like any given new fruit or vegetable. I would have received encouragement and gained much confidence by finding that for every person who disliked the mango, there were a dozen who liked it, and a half-dozen who were enthusiastic about it.

I made a test of the mango last summer. I sent some of the finest flavored fruits I have ever eaten to five ladies, wives of Cabinet officials, and at the same time I served the same or equally good varieties at the Cosmos and Press Clubs of Washington. One of the Cabinet ladies remarked, in regard to those which I had sent her, "I am very sorry, but we did not like the mangos." Another said, "I am deeply appreciative of your remembering us, and I was tremendously interested in the mangos, but I am constrained to be perfectly frank and tell you that we did not like them. It is just possible that they are one of the foods for which one could cultivate a taste, but it apparently is not a natural one with any member of my family." Another of the ladies remarked, "We found the mangos which you so kindly sent most delicious. This fruit would add exceedingly to our list of edible fruits." Another replied, "The mangos were perfectly delicious. Never in Mexico did I eat better, and I am delighted to know they are being grown in this country, for now they will be in the market here." Still another of the ladies who had eaten the mango before reported, "But, really, I never ate such fine mangos either in Mexico or the West Indies." Can you imagine the cold chill which settles down on a pioneer when he first starts out with a new fruit if, early in its history, he runs into a "throw down" such as two ladies of such prominence socially have given him, or how his spirits rise when he finds that three out of five are of quite the opposite opinion, or how he begins to see things differently when he makes a trial such as I made last summer in the Cosmos and Press Clubs of Washington and discovers that out of eighty-five who tasted the mango only four diliked it and that there were a large proportion of them who pronounced it delicious. Only one condemned it with the words, "It is too sweet. I dislike the flavor." I once opened a delicious mango and showed how it should be eaten, to the manager of the famous Touraine Hotel, and he turned it down as something his guests would not like. Therefore they never got a chance at it. So far as the mango is concerned there is no longer any doubt in my mind that most of those who do not like it could easily acquire the taste for it if they cared to overcome their prejudice against it.

Think what the eating of an orange means to a child, the peeling of it, the separation of the segments, the disposal of the seeds and indigestible fiber, the oil which covers his hands and poisons his mouth if he tastes it. I can still remember the oranges of my childhood, and as I look back upon them the eating amounted to a ceremonial. Today, even, the eating of an orange on a Pullman is not an easy thing to do gracefully. We forget these things and try, without the preliminary instruction, to get people to eat such a fruit as the mango or the Japanese persimmon and are surprised that the public laughs at us.

The story is told, and I believe it, of an Englishman of the seventeenth century (tea was so rare at that time that it was a privilege to be allowed to touch the tongue to a few leaves of it) who,

PICKING CHAYOTES IN FLORIDA

Before a new vegetable like the Guatemalan chayote can be given a fair trial it must be grown on a reasonable scale and its advantages and disadvantages studied from various angles. Its productiveness per acre, its liability to disease, the season of production, its storage qualities and the recipes which will bring out its particular character all require the elements of time and quantity. With only a few vines, these factors cannot be satisfactorily determined. In texture the Chayote appears to be unrivalled by any other vegetable. It will carry any flavor imparted to it by gravies or sauces or by pickling. (Photograph by Fairchild. Brooksville, Fla. Nov., 1918.) (Fig. 12.)

when asked by a friend, who had given him some Russian tea, how he liked it, replied, "Well, you know we found it a trifle tough." He had tried to eat the leaves! A friend of mine recently took an avocado (alligator pear) up from Florida to New England as a present to his people. "Of course, they knew how to serve it!" In the middle of the dinner, as the salad course was approaching he was called into the kitchen to show how the avocado should be servèd, and he found that the cook, in trying to peel it, had let it slip out of her hands on to the floor, and, in trying to cut it in half, struck the stone and was trying to cut that with a hatchet. Yet this is the staple food of millions of Guatemalans who can no more imagine intelligent people having difficulty in eating an avocado than we have in imagining how one should eat an apple.

I think there is no doubt but that the difficulties of preparing good corn bread have stood in the way of the use of this excellent food by the peoples of Europe, just as our ignorance of how to cook rice properly has prevented our consumption of that cereal from exceeding 7 pounds per capita.

We have underestimated the size of the task. To plant a tree of a new fruit in a botanical collection and expect the public to take it up is a good deal like making a new tooth powder in a test tube and waiting for a demand for it to spring into existence. In the Pinchin Garden in Rome stands an avocado tree over one hundred years old, and the only people who gather the fruits are the members of the Mexican Legation.

THE CHAYOTE

Take the chayote as an example. A few French descendants near New Orleans, Charleston and Savannah have for many years grown with varying yearly success a small patch of what they there call the Mirliton, or mango squash. They have generally sold what they grew, but the demand has not increased. Only a very small circle of the fashionable people knew it, and those who were not fashionable hesitated to try it. We have taken up its cultivation on a larger scale, and we find that instead of a few plants we need at least an acre of trellises and hundreds of vines, and we are planning for the production of a thousand bushels of the fruits which, with the most carefully thought-out literature to accompany it, will be sent out to the commission houses and the public generally. Hundreds of bushels have been so distributed this year and last, with two results—a growing demand by the trade on the one hand and, on the other, a local interest in them by people who could grow them in their own yards for their own use. The propaganda lifts the vegetable from the rank of a curiosity which "neighbor Jones is growing" and puts it where it belongs, as a perfectly good vegetable with certain characteristics, distinguishing it from all others and making it a valuable addition to the table.

Much fun is poked at the Florida "Cracker," but, after all, it must be admitted that we owe the grapefruit to his open-minded attitude towards new foods; whether born of the necessity of isolation or not, is another question. If canned fruits had been cheaper and easier to get in the early days in Florida, perhaps we would not have the grapefruit at all.

But, after all is said, perhaps the greatest obstacle to a satisfactory testing of new foods lies in two curious facts. It seem to be human nature to ridicule a food which one does not like oneself, and to attribute health-giving or disease-producing qualities to the food one eats. This is not only an individual trait, but a universal one.

Upon the walls of a quaint little hotel in Doylestown, Pa., I found in my bedroom last year an interesting old woodcut depicting the departure of the French soldiers for England, and under it were these lines:

"With lantern jaws and croaking gut
See how the half-starved Frenchmen
strut,
But soon we'll teach those bragging foes
That beef and beer give heavier blows
Than lamb and roasted frogs."

A WEST INDIAN YAM

A freshly dug Yam (*Dioscorea alata*) still attached to the vine, from the Yam patch of Mr. O. P. Wernicke of Brooksville, Fla., who has going this starchy tuber producing vine regularly for ten years, and Mr. Wernicke and his family have become as fond of these Yams as they are of potatoes. When the War Trade Board was obliged to restrict exports of wheat to Trinidad, the Yam came to be grown extensively and became a popular vegetable there. When cooked and properly prepared it resembles mashed potatoes and is a delicious table vegetable. (Fig. 13.)

A similar attempt to maintain the superiority of our own national food appears today in the writings of some of our foremost food chemists. Osborne attributes the drift of the Japanese toward our menu to an instinctive craving for a higher protein diet, but just how he arrives at such a conclusion I fail to understand, since the Japanese have copied our hats, our umbrellas, our shoes, our coats and trousers and even our furniture, and certainly there is nothing instinctive to be found in these imitations on the part of a smaller for the habits of a greater, more powerful nationality. Even McCollum, in his excellent book, makes the statement, unsupported by any carefully considered evidence. I am afraid that the peoples who drink milk and eat butter and meats are larger than those who get their "fat soluble A" from green vegetables. Galton's studies on the inheritance of height represents the method, it seems to me, that it will be necessary to follow to arrive at any satisfactory conclusion on this subject, and I am disposed to consider the statement as an expression of an idle notion and a neglect to consider the rôle played by heredity.

The pigmies of Africa live side by side with the normal sized blacks—do they eat different foods? The Terra del Fuegans are a large race—is their size determined by their food?

As I have said, to ridicule a perfectly good new food by comparing it to some food stuff used for the lower animals is perhaps the commonest form of ridicule. I cannot consider it as anything but foolish and short-sighted that the Irish should have come to look upon corn-meal as "food fit only for hogs," Only the feeblest propaganda has been raised against such an attitude. Our wheat shortage during the war rose in part at least through the inability of Europeans to eat our corn, and when I look for signs of any advertising to teach them, I find that none worth mentioning was ever made. When the war came it was perhaps too late. "Cornmeal" Murphy was not financially supported. He was like John the Baptist, crying in the wilderness. He complains that he had to give up because he could not raise the funds, and Dr. C. V. Riley, then Assistant Commissioner to the Exposition, in refusing to help him stage a corn show at the Paris Exposition, pleads the usual lack of appropriations.

Ridicule of new foods has hindered their proper testing, and magazines and newspapers still have funny writers connected with them who fail to see anything great in the attempts to introduce new food plants. They make fun of the avocado as a rich man's food, though it is the food of the poorest *cargador* in Guatemala, and of the dasheen as a bearded potato, though it forms the food of millions where the potato cannot be successfully grown.

In Panama, the natives back from the coastal ports give as an excuse to their guests for not having any vegetables, the fact that they are too far from the coast, where the potato is imported. It is the fashion to eat imported potatoes in Panama just as it is the fashion to eat French bread (*El Frances*) in Guatemala, even though potatoes do not grow well in Panama and wheat doesn't grow at all in Guatemala. These are serious questions, and they deserve a much more serious consideration by agriculturalists and educationalists.

I have no wish to discuss with individuals whether they should or should not eat cheese or ice cream to excess or drink coffee—these are questions for disputation and are generally fruitless —but I do maintain, as the result of twenty years of study and experimentation, that the question of testing new foods must and will go on to a broader basis than it hitherto has occupied. When it does, I believe we will find that the greatest, most progressive races will reach out after all kinds of foods that are good; and with the same hospitality of mind which has characterized the Americans in their adoption of new labor-saving machinery, I believe our countrymen will test with interest many new foods and learn to use so many kinds that it will be profitable to grow those best adapted to each agricultural

region and season, because there will be the necessary demand for them. How far the change from one food to another is essential to health is a question for the dietitians to settle, but I do insist that the whole question of testing new foods must rise from the slough of foolish neglect, where it remained almost from the time of primitive man, to the plane it deserves to occupy, for, after all, we are not certain we have the best. We know a few food plants cannot grow everywhere, and the whole drift of evolution is towards a greater variety of all things—foods as well as other things.

New foods (new species, not only new preparations) must, and I believe will, be tried out on as great a scale as that which characterizes the advertising campaigns for cereal foods. When that time comes many of the new plant foods will come into their own and compete with the old and form natural agricultural monopolies where they grow the best.

We would indeed be supine if, blind to the lessons of this great war, we dropped back into the same old rut in our education with regard to the rôle which is being played in agriculture through the foolish, unreasoning and unjust popular ridicule of the great foods of the world. Narrow-mindedness in the food habits of the people is as much to be avoided as narrow-mindedness towards labor-saving machinery or towards morals or government or religion. The restricted menu affects the essential function of eating and so effects the adaptability of the species and hinders its evolution.

Racial Problems and World Problems

A recent meeting of the newly formed Galton Society took place in the American Musum of Natural History. It was preceded by a luncheon at which the members present were the guests of Professor Henry Fairfield Osborn and Mr. Madison Grant. The following members and guests were present: Professor E. G. Conklin, Mrs. William H. Crocker, Dr. C. B. Davenport, Dr. Gregory, Mr. Madison Grant, Mrs. E. H. Harriman, Professor Huntington, Professor McGregor, Professor Merriam, Professor Osborn, Dr. Lothrop Stoddard, Professor E. L. Thorndike, Dr. Wisslor, Dr. F. A. Woods.

Professor Merriam, of California, spoke of the place anthropology should hold in the universities. In order to make the discussion concrete, he gave a brief outline of the history of the anthropology in the University of California. When the department was started everyone thought best to begin with the local anthropological problem, in other words, with the study of the California Indians. Under Professor Kroeber this work has been carried to a very satisfactory conclusion and, while a great deal more work could be done, it seems that a point had been reached where new problems should be undertaken. The speaker thought this was typical of anthropology in America. Everywhere the feeling had been, and rightly, that attention should be given to the problems at hand. The result is that we have a very systematic body of knowledge concerning the North American Indians, but have no contributing workers in larger anthropological problems. The effect of the world war and its broadening influences make it highly desirable that anthropology should be put upon a broader and more fundamental plane, particularly should it deal with problems concerning our own racial and national antecedents. The broadening of anthropology would also require the drawing in and coördination of much that has been done in psychology, biology, neurology and history.

THE FIGHTING ABILITY OF DIFFERENT RACES

Letter from an American Officer, with Comments by John Jay Chapman and Henry Fairfield Osborn

NO ADEQUATE scientific studies have ever been made on the comparative fighting ability of different races. The "warring instinct," or gregarious group-instinct, is something quite apart from any desire to fight single-handed, to quarrel with one's neighbors, to go about with a chip on one's shoulders, or to start trouble out of nothing. The most polite and peaceful morals may make the best soldiers under the stimulus of group conflict.

The readiness of nearly all peoples to respond to this group-instinct for war is not difficult to explain on grounds of heredity. Mankind has been devoting presumably half of its time to warfare, so that any groups lacking that instinctive tie that binds so marvelously one to all, would, by and large, have been hacked to pieces by more unified and organized groups. Or, in other words, those groups, compounded in the patriotic mold, with a maximum display of bravery and individual self-sacrifice, would survive as such, and in the long run exterminate less closely formed aggregates.

The disposition to act in a quarrelsome manner, to fight singlehanded, to murder, or to disturb the harmony of the social order represents a type of man that has been acted upon by natural selection in precisely the opposite way. Ever since human beings have lived in settled communities, persons of this sort have been seized upon by society and summarily dealt with, so that to a great extent these types have been eliminated.[1]

The willingness and, indeed, enthusiasm with which so many nations entered into the recent great war, as soon as the gregarious instinct reached a certain point of contagion, would seem to indicate the general or widespread distribution of the warring impulse. The countless evidences of bravery and marvelous self-sacrifice that have reached us from all quarters might give the impression that all people are equally brave and that there is little difference in the value of the fighting ability of different races.

This may or may not be true; but in the absence of systematic knowledge on this important question it is at least interesting to read the following letter contributed by Mr. Madison Grant, whose recent "Passing of the Great Race" has extended an interest in the applications of the study of heredity.

This letter was written to Mr. Grant by an officer who had become interested in racial questions and who evidently thinks that "blood will tell." It is published here in full recognition that it is merely the testimony of a single individual.

Mr. Henry Fairfield Osborn, who also sent to the JOURNAL OF HEREDITY a copy of this letter, has added some comment on the questions involved and has answered a criticism raised by Mr. John Jay Chapman.

HEREDITARY AND ACQUIRED FIGHTING ABILITY

American Museum of Natural History,
December 26, 1918.

For the "Journal of Heredity"

The following opinions, formed by one of the American artillery captains

[1] A fuller discussion of the results of warfare on human evolution, through the processes of natural selection and survival, may be found in "Is War Diminishing?" by Woods, F. A., and Baltzly, A., Boston, 1915.

in France, has some bearing on the racial distribution of the readiness to fight and of physical courage:

"It is interesting to learn about the relative fighting ability of the various races in this game. The Norman and Breton Frenchmen and the North French generally are the fighting men of France. Today they compose practically all the fighting troops left. The Scotchmen are the top-hole fighters of them all, Boches and Allies, and that seems to be admitted by all alike, while the Italians of certain divisions are utterly unreliable. A fighting Italian is as scarce as the dodo bird, in spite of all the newspaper bull to the contrary. . . . They are used entirely for road building and stevedore work about as far back of the lines as they can get. Some French troops told us that the Italians took over the sector we left between the Vesle and the Aisne when we pulled out of there, and in two days they lost practically all that we had won across the Vesle and were being walloped soundly by the Boches.

"There is not a bit of use denying that the Boches are brave men and fight like heroes. Their aviators are the finest fighters of the lot, with the exception of the British, perhaps. But how anyone can show greater sand or finer dash than the Boche aviators, I cannot understand. They may be devils, but they are fighting devils and have guts through and through. Between them and the Italians give me the Boches every time.

"As for our own troops, their fighting ability is in direct proportion to the Americans in the various units. Get a draft outfit filled with the kind that is swept up around our east side and it is just about as unsafe as anything in the Army; given an outfit like the Yankee division, or some of them with a full proportion of Americans, and there is nothing they are afraid of, nothing that will stop them short of death itself. In fact they're too darned brave if anything. That idiotic 'melting pot' idea is blown to the devil by this war if they tell the truth about the thing. But it is ten to one bet that they will lie and smooth the matter over in such a manner that you all at home will believe that anyone with an American uniform on is as good as another similarly dressed. Fighting men are born that way; you cannot drill the real stuff into anyone at all.

"I think that the Southerners and the New Englanders are the best of our lot, with no choice between the two. But you really cannot hand the palm to any of the Americans; they are all equally full of the greatest spirit that any man ever saw in war.

"I have seen no negroes fighting and have heard very different reports of them, but the experience of the French and British is that the lower races cannot stand the strain of this war, particularly shell fire, which is the hardest thing of all on the morale of troops. And I do not imagine that they are very good fighting troops, though they are invaluable as working troops, and one sees thousands of them everywhere on the roads right back of the lines and from there back to the docks at Brest itself."

The above, from a letter not intended for publication, is more or less confirmed by other observers. Of course it does not take into account the influence of training. It is an open secret, however, that in the first battle of the Marne, it was the men of Mediterranean race from the south of France who gave way and had to be rallied and replaced by sterner material from the north of France.

JOHN JAY CHAPMAN'S COMMENT

It is interesting also to see the comments on the above letter by a distinguished man of letters, Mr. John Jay Chapman, who does not believe in racial values in psychic qualities:

1. "Many thanks for letting me see the enclosed. I don't doubt that some races fight better than others. But I doubt whether you can scheme to preserve any particular race without doing more harm than good. If you accept the test of *survival* as the best test of a race, why it's only scientific to let the

matter alone. How do you know which one *ought* to survive? That's the very question you are trying to find out. You might as well put weights in the balance in weighing chemicals.

2. "The notion that we must boost up any race which is failing or assist nature in any degree violates the whole theory of the survival of the fittest.

3. "As for *which* race makes the best fighters, look at the Germans (whom the correspondent praises so highly) and see how they collapse. I don't think the world will regard the German civilization as efficient or the Germans as good fighters for some time to come.

4. "What basis are you going to get down to in *encouraging nature?*

6. "If modern science has discovered a formula that will tell us how to begin, I don't know the formula. This desire to help things along is a moral idea which science has borrowed from religion and ethics, etc., and which science can make use of in small matters, like hygiene. But the idea is unscientific or non-scientific, and I rather believe that it cannot be expressed in purely scientific language."

Considering the above report by one of our artillery captains, and the comments of Mr. Chapman, it must first be observed that it is extremely difficult to distinguish between hereditary and acquired fighting ability, the former an inborn predisposition, the latter the result of education and social environment. The matter is also one of averages rather than of individual instances and exceptions. Here, as well as in every other field of genetic inquiry, we must sharply distinguish between race and country.

An attempt is being made by members of the Galton Society to encourage a more precise physical and anatomical definition of the Nordic, Alpine and Mediterranean races respectively. Doubtless psychic definitions, or inventories of dominant and widely prevailing psychic traits and predispositions are equally important to place the races distinctively on a genetic or heredity basis.

HENRY FAIRFIELD OSBORN.

American Physicians Should Follow Suit

December 4, 1918.

THE AMERICAN GENETIC ASSOCIATION,
511 Eleventh Street N. W.
Washington, D. C.

GENTLEMEN:

For the past seven years I have been a resident of Rio de Janeiro and S. Paulo, Brazil. While in S. Paulo a very energetic young physician became interested in the study and propaganda of the science of eugenics. We invited him to give a lecture at our association building, which he did. As a result of his interest, an organization has been formed in the interest of eugenics, and its membership is composed of one hundred of the leading physicians in the city.

I am very anxious to foster this sincere effort, and appeal to you for suggestions and help. In what way can your organization advance the interest of the science through that organization?

I should appreciate your coöperation. Cordially yours,

ARTHUR W. MANUEL,
International Committee of Young Men's Christian Associations,
347 Madison Ave., New York.

GROWING MEDICINAL PLANTS IN AMERICA[1]

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Modern warfare may be roughly divided into two distinct phases: one is destructive and the other reconstructive. There are no longer crucial battles which decide the issue of war as at Waterloo or Gettysburg, but there is instead one protracted and unceasing effort to destroy the enemy's life and property on the largest scale possible. Nevertheless, the reconstructive work must follow the destructive on an equally gigantic scale. Never before in the history of mankind has such organization existed for the first-aid and subsequent treatment of the sick and wounded, and never before has there been such concentrated human and animal suffering calling for alleviation.

It is a curious dispensation of Providence that man first found, and still to a very large extent depends for his remedial and anesthetic agencies on, the familiar herbs and weeds which grow wild about his woods, fields and hedgerows. The term "drug" includes all substances used as medicines, as well as those substances which may be misused as intoxicants or anesthetics. Drugs may be mineral, such as the bromides, iodides, and chlorates of potassium, the mercurial, arsenical, and silver compounds and many others. In addition to these, modern medicine depends largely on the coal-tar derivatives, among which may be mentioned some of the more familiar, as, for instance, acetanilid, phenacetin, and the various salicylates, under such trade names as aspirin and salol, owned and exploited before the war exclusively by the Germans. The present paper, however, concerns itself particularly with the raw materials from which such medicinal agents as the alkaloids and glucosides are extracted. These are represented by morphine, cocaine, strychnine, atropine, quinine, digitalin, strophanthin aloin, etc., which are extracted from crude drugs imported into this country from overseas.

It is, however, more particularly the botanical drugs which can be grown under proper scientific control in the United States which we shall consider. Among these we find the following important medicinal plants: Aconite, belladonna, and stramonium, the principal source of atropine, digitalis (foxglove), cannabis indica or Indian hemp, the active principal of which is known in India as hashish, the properties of which the elder Dumas so beautifully misdescribes in "The Count of Monte Cristo."

Among our native medicinal plants we also use in fairly large quantity henbane, rhubarb, senna, gentian, golden seal (hydrastis), senega, mandrake, bloodroot, arnica; ajowan seeds, and monada punctata, used in the manufacture of thymol, a specific in the treatment of the hookworm disease, and many others too numerous to mention. If a layman, unaccustomed to the study of such subjects, were to pick up one of the great New York commercial daily newspapers which quote prices in the drug markets and were to glance over the items quoted he would probably be very much astonished at the familiar herbs, roots, and flowers which

[1]Reprinted from the *Journal of The Franklin Institute*, September, 1918, with additional comment by the author on the present situation.

HARVESTING DIGITALIS LEAVES

A FIELD OF CANNABIS

are made a matter of almost daily barter and sale, the manifold uses of which constitute some of the mysteries of our enormous patent medicine industry. There are warehouses in the heart of New York City filled with great bales of things familiar to our childhood days: cornsilk, daisy tops, red clover tops, laurel leaves, skunk cabbage, flagroot, burdock, dandelion, gentian, lily-of-the-valley, wintergreen, and many another of our old friends of the fields and woods. The inquirer might also be surprised to learn that these familiar things command a price varying from cents to dollars per pound and he might even solemnly determine to turn his newly acquired knowledge to profitable purposes and forthwith embark in the combination of business and pleasure of producing and purveying herbs and simples. Unfortunately, however, for this laudable ambition, it would soon become apparent that the labor involved, for instance, in gathering two bales of green corn silk or something else which shrinks to one bale on drying is quite inadequately paid for by the prices offered by the stony-hearted buyers in the New York market. In fact, it would probably be learned that, although America produces more corn silk or something else than all of the rest of the world together, from time out of mind the baled corn silk or something else has been imported from overseas, where child-labor laws are unknown and where people's wives, mothers, and grandmothers are more interested in acquiring a few extra pennies a day by working in the fields than they are in acquiring a vote.

Seriously speaking, the production of medicinal herbs in America depends very largely on the labor cost, and can be made a profitable enterprise only when it is conducted on a scientific basis and on a sufficiently large scale to absorb the high cost of the labor involved in the tilling, planting, cultivating, harvesting, curing, and packing operations. At the same time, the drug grower faces a most uncertain and precarious market for his wares, for, although his drug plants are needed, the need is strictly limited, and the slightest overproduction is either entirely unsalable or salable at a price less than the cost of production.

A well-known authority on drug growing, Mr. H. C. Fuller, has recently said in effect: "The cultivation and marketing of drugs must be done under an entirely different set of conditions than those obtaining in the growing and selling of vegetables. Much that has been published on the subject is misleading, and the idea that the ordinary farmer can successfully grow drug plants and produce a marketable article is ridiculous. It can be confidently asserted that if the ordinary farmer should undertake the growing of drug plants it would result in failure to him as well as discredit to the efforts of those who are specializing in the subject."

Dr. W. W. Stockberger, the expert of the United States Department of Agriculture, in charge of drug and poisonous plant investigations, expresses the same fact is the following words:[2]

"If medicinal plant cultivation is to succeed in this country it must be placed on a sound commercial basis, and there are good reasons for believing that this end will not be attained by encouraging a large number of persons to engage in drug growing on a small scale." . . . "If the drug manufacturer is to become permanently interested in medicinal plants produced in this country he must be assured of a fairly large and dependable source of supply. For this reliance must be placed upon well-equipped growers who have sufficient capital to carry on the enterprise effectively."

Still another writer on this subject has recently published the following comments:[3] "In the strictly pharmaceutical field the shortage of crude drugs has been felt more or less keenly since 1914, and much misinformation and little information of value have

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[2] *The Druggists' Circular,* January 18, p. 5; *ibid.,* March 18, p. 106.
[3] *Journal Franklin Institute,* vol. 185, No. 3, p. 435.

PLANTING BELLADONNA SEEDLINGS AT THE RATE OF SIXTY TO THE MINUTE

These are planted at the rate of sixty to the minute. Belladonna and digitalis have to be propagated in a greenhouse during the winter in order that the plants, when set out, will be large enough to cope with the ravages of insects and crowding out by weeds. (Fig. 16.)

been circulated on the subject. Stocks of many crude drugs have been exhausted, and the cultivation of medicinal plants has not as yet assumed any great proportions in the United States. Those drugs which were obtained from Europe were not cultivated, but grew wild there. It was therefore a simple matter to have them gathered and prepared for market at comparatively small cost. The cultivation of medicinal plants in the United States requires expert labor, the production of artificial conditions of soil and moisture in order to provide as nearly as possible the conditions under which the plants grow in their native habitat, and considerable investment of money. Drug plants have been raised on an experimental scale by the Government and in the drug gardens of various colleges, but it is a very different undertaking to raise them on a commercial scale. American growers of crude drugs were confronted with the necessity of increasing the value of the plants in order to overcome the high cost of cultivation. It was soon found that cross-pollination would not produce plants containing more active constituents than they do normally, but by careful selection of seed it has been possible to increase the amount of active constituents in such plants as belladonna, digitalis,. etc., to three or four times what the Pharmacopoeia requires. Furthermore, advanced methods of harvesting these plants have made it possible to secure three or four harvestings in one season, whereas in former years one or two was the limit."

The experience gained by the author in the production of certain drug plants extending over the past three years confirms the statements of the experts quoted above. The fact is very clearly brought out that the so-called "backyard" movement, however much it may stimulate vegetable gardening and poultry raising, is not applicable to the growing of medicinal plants. The U. S. P. requirement for dry belladonna herb or leaf calls for an assay showing a content of not less than 0.3% atropine alkaloid. Any substantial quantity of active constituent in excess of this prescribed minimum should, if the producer is aware of it, be credited in the price paid by the consumer. The small producer can have no knowledge of the assay value of his product unless he employs the services of a chemical laboratory. Such chemical assays require special highly paid experts in order to obtain accurate results, and the cost of such service is naturally high. In the opinion of the writer, unless a producer is able to hold his belladonna to an assay value at least twice as strong as the U. S. P. requirement, it would not be worth producing at all under American conditions. Such high-potency crude drugs can be obtained only by the application to the problem of trained scientific knowledge. Plant breeding through seed selection and a knowledge of just the day to harvest when the alkaloidal content is at the maximum, together with proper control of the drying operations, constitute a large part of the secret of success. All this necessarily hangs upon the results of laboratory investigation, which must go on hand in hand with the agricultural operations. The author and his associates have produced belladonna in bulk running almost 1% alkaloid-atropin.

Other important medicinal crops, such as digitalis and cannabis, present a special problem, inasmuch as the active constituents are not determinable by chemical assay, but depend upon certain specific physiological tests which require the services of another group of trained specialists.

In marketing crude drugs the pharmacopoeial requirements must be met, no matter how irrational these may be. The requirement on cannabis calls for the dried flowering tops of unfertilized pistillate or female plants only. This specification requires that before the male plants pollinate experts must go over the entire crop, plant by plant, and distinguish and destroy every male individual. Immediately the visible crop shrinks approximately 50%, and also adds to its cost of production the cost of this wholesale weeding operation. This requirement also necessitates the seed gardens being remote enough from the main crop to prevent wind-blown pollen from reaching the female survivors. In order to test the necessity for this requirement, the author, in coöperation with Mr. H. C. Fuller, gathered from the seed gardens flowering male tops, which were dried, powdered, and bottled. This sample, together with a pharmacopoeial sample bearing distinguishing numbers but no other information, was sent to the physiological laboratory of the Harvard Medical School. The report showed the male sample was the more physiologically active of the two. Although the pharmacopoeial requirement is probably a survival of some superstition originating in India, the drug-plant grower is held rigidly to it, and it is extremely unlikely that any buyer would purchase the crude drug in the powdered form, as the dried flowers must be present so that inspection will detect the presence of male plants. If such specifications are annoying to the commercial drug grower, they would be found intolerable by an ordinary farmer who might otherwise feel inclined to undertake the production of this special crop.

All medicinal plants are intensely poisonous to animals, but, curiously enough, most of them are very attractive to predatory insects. Possibly insects share with man a weakness for certain things that would better be let alone. However this may be, the author has determined by actual experi-

ment that the flea beetle consumes about 5% of every crop of belladonna grown, in spite of the most liberal use of insecticides and agricultural spraying machinery.

Henbane, the crude drug from which hyoscyamine is made, sells at about $4 a pound on the dry basis, and is worth it, owing to the eagerness with which insects appear to lie in wait for every green shoot as it appears. In the course of the author's experience potatoes were grown in the neighborhood of henbane, in the hope that it would act the part of a decoy crop. Unfortunately, however, the potato beetles preferred the henbane, and—if we may be permitted to drop into the vernacular—returned to their own homes only after all the other places were shut up.

Among the medicinal plants which the author and his associates have attempted to grow commercially in Virginia and Maryland, many of them successfully, are belladonna, digitalis, cannabis, sage, hydrastis, ginseng, stramonium, monada punctata, pinkroot, valerian, senega, colchicum, etc. Of these, the first two have to be propagated in a greenhouse during the winter in order that the plants, when set out in the field, will be large and vigorous enough to cope with the ravages of insects and crowding out by weeds. The greenhouse soil has to be especially sterilized to prevent the spread of a special fungoid root-rot disease to which belladonna is especially susceptible and which follows the seedlings from the greenhouse to the open fields. During one season the writer lost over 50% of his belladonna crop, due to root-rot. So suddenly did the disease show itself that on one day the bushy plants, about two feet high, were flourishing in the field and the next day were found wilted down and dying. The roots of belladonna are rich in atropine and are usually dug up and sold after a succession of leaf crops have been gathered, so that the loss from root-rot is most discouraging and baffling.

This paper has not attempted to discuss drugs or drug growing in their technical aspects, but merely describes a few of the conditions and difficulties encountered by a group of associates who entered the field with no expectation of making large profits, but with the patriotic purpose of demonstrating, if possible, that American methods were capable of making us independent of central Europe with respect to some very necessary medicinals.[4]

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[4]The results obtained during the harvest year of 1918 fully justified the careful work of seed selection that has been carried on during the past years, as the active principles in the various crops mentioned were kept up to the standard aimed at. This result was obtained in spite of the fact that not only was the labor situation during the war year extremely acute, necessitating paying higher wages to inefficient and ignorant labor than were previously paid to expert labor, but also the weather conditions during the summer season of 1918 rendered the handling of special crops very difficult. In the early spring there was a long rainy period which held back plowing and setting of plants, and this was followed by an extensive drought which lasted for twelve weeks, both conditions being unfavorable to agricultural operations. In addition to this, supplementing what has been previously touched upon in the preceding article in regard to the relation between the successful growing of medicinal plants and insect attack, it may be recorded that during August of this year a flight of a peculiar and unusual kind of potato beetle appeared upon the scene and attacked the belladonna, consuming a considerable quantity of the crop before the new insect was recognized and measures put into effect to control it. In addition to the usual medicinal plants, the growing of which has been described in this article, several new crops were produced in a small way, which had not heretofore been successfully grown and marketed in this country. This development work, it is hoped, will be carried on from year to year as opportunity of success seems to promise.

A LABORATORY MANUAL FOR GENETICS[1]

COURSES in genetics have been on the rapid increase in the last few years, but the subject is so new that they have scarcely yet crystallized into any very definite form or content as given in different institutions. With the fuller growth and rounding-out of the subject, however, and with the advent of more suitable texts, there is evidently a tendency toward a more definite order in the presentation of at least the more elementary facts. The value of laboratory work to supplement that of the classroom has doubtless been appreciated by all who have taught genetics, but here the selection of the most suitable exercises has been even more difficult than a choice of material for lecture presentation. Obviously, for an understanding of Mendelian inheritance, nothing else is so valuable to the student as the actual performing of experiments involving crosses, and the study of dominance, segregation, recombination, and other such phenomena, in at least the first and second filial generations. Fortunately, the very characteristics that have made Drosophila the form *par excellence* for genetic research, make it also well adapted for laboratory class purposes. This fact has been recognized by numerous teachers of genetics in this country, who have been making use of Drosophila in connection with their elementary teaching for some years. It is accordingly not surprising to find that breeding experiments with the "vinegar fly" form the backbone of the course in this the pioneer of laboratory manuals in genetics.

It seems somewhat presumptuous to attempt to give an estimate of a manual of directions without first having tried them out in practice, even by one who has been giving much of the same work to his own classes. The old proverb asserts that the real test of a pudding is not to be gained by inspection, but by chewing the string; this is even more true of laboratory manuals than of puddings, and there has been no opportunity to apply the string test in the present case. Nevertheless, one may, perhaps, be allowed to hazard an opinion on the basis of parallel experience.

The principal experiments outlined on Drosophila are along obvious lines, and are designed to illustrate normal Mendelian inheritance, sex-linkage, and mono and dihybrid ratios. Experiment VI involves the question of factor groups (corresponding to the chromosome pairs), but no experiment on the degree of linkage of two factors in the same group is given. The advisability of including this in an elementary course may, without doubt, be questioned, but where as much time can be devoted to the course as in this one, it might, perhaps, well be offered at least as a substitute. The character differences selected for the breeding experiments are well chosen, and a feature that will doubtless appeal to those who give the work to successive classes of elementary students is the provision of alternate characters for each exercise, which can be substituted from year to year. Two alternatives are given with each exercise.

The suggestive work on variation in plants is based on readily accessible material, and the suggestion of having the student prepare an herbarium of variation is a good one where such material

[1] Genetics Laboratory Manual, by E. B. Babcock and J. L. Collins. First edition, xi + 56 pp. McGraw-Hill Book Company, Incorporated; New York, 1918.

is available. The work often comes at such a time, however, in most of the northern states, that dependence would have to be placed largely on greenhouse material.

Seasonal restrictions and lack of greenhouse facilities will also probably limit in many cases what can be accomplished in the way of having the student perform actual experiments in plant Mendelism; but while the directions in this respect cannot, perhaps, often be adopted as they stand, they are very suggestive and should help an ingenious instructor to work out practicable plans to meet his own conditions. The suggestion of having F_1 seed that the student can plant in order to study segregation is a good one. This will work out particularly well, for example, with green and purple-stemmed Daturas, since the segregation of stem color can, in this case, be observed in the seedlings, and these can be raised in large numbers in a short time in small germinating pans in an ordinary room.

The feasibility of giving the work on plant hybridization (practice in cross-pollination) will again depend on facilities and other conditions. The selection of types would be difficult to improve, but it would perhaps have added much to the usableness of this section if illustrations had been supplied, showing the instruments to be employed, and the methods of performing the operations.

Practical work in animal breeding (aside from that on Drosophila) is even more difficult to bring into a regular laboratory course than is work with plants. The suggestions along this line deal with registry methods with cattle, a subject which is, in most agricultural colleges, included in the course in Animal Husbandry. It is important, of course, that students interested in genetics in relation to agriculture should get this knowledge, but it would seem that it would have been well to include also some training in the methods of keeping breeding records more particularly for genetic uses.

Putting out a laboratory manual, particularly in a new field, is a somewhat precarious venture, since every instructor is likely to have his own ideas as to material and methods! or at any rate, as previously mentioned, he is likely to be limited by his available facilities and the condition under which his work must be given. It would, therefore, be somewhat hazardous to venture an opinion as to how completely these directions can be adopted without modification, but the reviewer has no hesitation in saying that any teacher of genetics, whether or not he has previously been offering a laboratory course, will find the manual full of useful suggestions. In places, in fact, it would appear to be addressed more directly to the instructor than to the student. Nevertheless, if it helps to stimulate, as no doubt it will, the institution of laboratory work in connection with courses in genetics, where such work has not previously been given, it will serve a most useful purpose.

L. J. C.

The Basis of Crop Reports

The Bureau of Crop Estimates, United States Department of Agriculture, maintains 199,384 voluntary crop reporters, to whom schedules of inquiry regarding crop and live-stock conditions are forwarded periodically. These schedules are tabulated and averaged.

The data thus collected and compiled, supplemented by reports from the field service, constitute the basis of the monthly and special crop reports of the bureau.

RACE MIXTURE IN HAWAII

By Vaughan MacCaughey
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THE CHINESE

THE Hawaiian Islands are remarkable for the diversity of races represented and for the varied conjugal race-mingling which has taken place in this tiny island world during the past hundred and fifty years. Excellent general accounts of the nature of Hawaii's population can be found in W. F. Blackman's "The Making of Hawaii" (Macmillan, 1906, 266 pp.) and in "Race Mingling in Hawaii," by Ernest J. Reece (*American Journal of Sociology,* 20:104-16, July, 1914).[1] The present paper is the first of a series of eugenic studies of Hawaii's polyglot and polychrome population, a series which embodies data not heretofore assembled and made available for students of eugenics.

The population of Hawaii, 1918, in round numbers is as follows:

Asiatics		153,500
Japanese	105,000	
Chinese	23,000	
Koreans	5,000	
Filipinos	20,000	
Polynesians		40,000
Hawaiians	23,000	
Caucasian-Hawaiians	11,000	
Chinese-Hawaiians	6,000	
Latins		31,000
Portuguese	23,000	
Spanish	2,000	
Porto Rican	6,000	
Americans, Scotch, British, Germans, Russians, etc.		22,000

The Hawaiians are remnants of the splendid Polynesian stock that formerly solely possessed this lovely mid-Pacific archipelago. The Americans, North Europeans and other "white men" represent the traders, missionaries, beachcombers, sailors, fugitives from justice, merchants, sugar planters, professional, military and capitalistic classes that have completely dominated and exploited the life and resources of the islands. All of the other races—Japanese, Chinese, Korean, Filipino, Spanish, Portuguese, Porto Rican, Russian, Negro, South Sea Islanders, etc.—have been *imported* wholesale by the agricultural corporations to work in the sugarcane fields. At present the population of Hawaii is predominantly Asiatic, alien, male, illiterate, non-English-speaking, non-Christian, landless, and homeless.

The Chinese have been associated with Hawaii since very early times The first epoch in Hawaii's industrial exploitation was the "Sandalwood Period," during which an active trade was carried on with China. Chinese coolies began to be imported in small numbers about 1870. The flood of coolie labor swelled rapidly and reached a maximum about 1870. The exclusion law, which went into effect with annexation in 1898, has decreased the number of Chinese immigrants. The immigration of foreign-born Chinese into Hawaii to 1910 has been as follows:

Previous to 1890	6,580
1891–1895	3,340
1895–1900	3,830
1900–1905	445
1905–1910	205

The Chinese now number 23,000; the increase during the past decade has been slight. There are now 800 registered Chinese voters in Hawaii. In 1900 there were almost as many Chinese children (1,300) in the public and pri-

[1] See also Vaughan MacCaughey, "Americanization and the Schools of Hawaii," in School and Society, 8: 24-26, July 6, 1918, and "Racial Elements in Hawaii's Schools, in Education," in press.

vate schools as Japanese (1,350). The Chinese, however, have increased only to 4,000, whereas there are now 15,000 Japanese children. Chinese form 10% of the total school population; the Japanese form 40%. Only 2,000 of the Chinese in Hawaii are now working on the sugar plantations. Reece states: "The Chinese in Hawaii are all from Quantung and largely from Canton. They exhibit, therefore, the racial characteristics of the southern Chinese, being short, dark-skinned, and suggestive of Malay extraction. Their mental traits are those of the Chinese in general. They are plodding, thrifty, inveterate workers, content with simple living, stolid, and capable of excelling in those activities which involve memory and imitation rather than originality."

Table 1 (see Appendix) shows the racial elements involved in all Chinese marriages in Hawaii during the five-year period 1913–1917. Accurate data are not available for earlier years, but the essential facts concerning race mixtures would be substantially the same if records covering a longer period were available. The data are from the official records of the Territorial Board of Health.

MARRIAGES OF CHINESE

The racial preferences shown by the Chinese men may be grouped as follows: 58% chose Chinese wives, 10% chose wives of mixed Chinese blood, 20% chose Hawaiian wives, 14% chose wives of mixed Hawaiian blood. None married Korean women, and only 4 married Japanese women. Of the 613 matings, 425 married Asiatics, 167 married Polynesians, and 14 married Caucasians. Nearly all of the Chinese women married Chinese men. Seven married Chinese-Hawaiians, 6 married Americans, and 4 married Hawaiians. Only 1 married a Korean, and only 2 married Japanese.

Nearly all of the Chinese-Hawaiian men selected wives with Hawaiian blood, either pure Hawaiian, Caucasian-Hawaiian, or Chinese-Hawaiian. Only 7 out of 173 married Chinese women. None married Japanese, Koreans, or Filipinos. Eight married Portuguese. The Chinese-Hawaiian women likewise selected, or were selected by, men of Hawaiian, Caucasian - Hawaiian, or Chinese - Hawaiian blood. Fifty-nine were married by Chinese men, 15 by Americans, and 15 by Portuguese.

Of the 240 Chinese-Hawaiian women 97 married Asiatic husbands, 109 Polynesian husbands, and 32 got Caucasian husbands.

CONCLUSIONS

Over half the Chinese men marry Chinese women, while most Chinese women marry Chinese men. A large percentage of the Chinese men marry Hawaiian or part-Hawaiian women. Very few Chinese women marry Hawaiian or part-Hawaiian men.

FEW MARRIAGES WITH AMERICANS

Only one Chinese man has married an American woman; a few Chinese women have been married by American men.

An appreciable amount of mingling has taken place between the Chinese and the Portuguese; Chinese and Chinese-Hawaiian men marry Portuguese, Spanish, Hawaiian, Caucasian-Hawaiian, etc. Chinese-Portuguese men and women marry Portuguese, Spanish, Hawaiian, Caucasian - Hawaiian, etc. There is remarkably slight mingling between Chinese and Japanese or Koreans. A few Chinese men have married Japanese women, and a few Chinese-Hawaiian women have been married by Koreans. There have been a few marriages of Americans and North Europeans with Chinese and Chinese-Hawaiian women; the Caucasian mingling is chiefly through the Caucasian-Hawaiian, who intermarry freely with the Chinese and Chinese-Hawaiians.

The most significant feature is the large number of mixed marriages, in which the Chinese, Hawaiian, and Caucasian strains intermingle. Reece states: "There seems to be no reason to doubt that the mixing will proceed at a mod-

erate rate. This does not, of course, mean that Hawaii will be given over to the Caucasian-Hawaiian-Chinese race. The Japanese are predominant numerically, and promise to remain so. The Portuguese constitute a bulky element. Both are prolific, and neither contributes considerably to the fusion. What is likely to appear is the gradual growth of the new stock, fitting itself for leadership in the minor business and clerical activities of the islands."

JAPANESE AND KOREANS

Nearly one-half of the total population of Hawaii is foreign-born. Of the 110,000 foreign-born population, about 70% are Japanese, about 15% are Chinese, and the remainder are Koreans, Filipinos, etc. Asiatics comprise *over five-sixths* of the total foreign-born population. The Japanese are racially dominant in Hawaii today, and will doubtless so continue for many decades. They are very fertile, and have already reached the point of comprising over 40% of the total school population. There are now over 15,000 Japanese children in the schools; in 1900 there were only 1,300. The Japanese population numbers 106,000, or *nearly one-half* the total population of the territory. It consists largely of alien males. The Japanese have been the backbone of Hawaii's extremely profitable corporation cane-sugar industry. At present there are only 26,000 Japanese at work on the sugar plantations. Most of the Japanese were imported before annexation to supply the demand for cheap field labor. Immigration began about 1886, and since that date there has been a large and steady stream of alien laborers coming into Hawaii from Japan. Extensive immigration is taking place *at the present time,* in the form of "picture brides," who rapidly become the mothers of prospective "American citizens." The Japanese have increased 23,000 in seven years, both by birth and immigration.

The immigration of foreign-born Japanese into Hawaii for a typical series of years has been as follows (see also appendix):

Previous to 1890	3,330
1891–1895	4,340
1896–1900	16,390
1901–1904	10,350
1905	3,180
1906	8,240
1907	9,205
1908	3,070
1909	1,070

The tourist upon coming to Hawaii is impressed by the large numbers of Japanese women employed in domestic service. As a class these women are attractive, intelligent, clean, polite, and serviceable. They wear Japanese clothes, and are always picturesque and neatly attired. The American-born Japanese girls usually wear American clothes.

During the past decade there has been a heavy influx of Japanese women into Hawaii, chiefly as "picture brides." Statistics for a typical five-year period show Japanese women immigrants as follows:

Year	*As laborers*	*As non-laborers*	*As "picture-brides"*[2]
1912	1,447	77	
1913	2,130	95	1,572
1914	1,842	217	1,407
1915	1,126	232	1,050
1916	1,157	151	909

The picture brides are selected in Japan by intermediaries or middlemen upon requisition by the Japanese in Hawaii who desire a wife. Two ceremonies take place, one in Japan, in the absence of the husband; the second at the Immigration Station in Honolulu, according to American law. These

[2] These numbers are duplicates, also included in the other two columns.

brides-to-be are almost without exception plantation laborers, and they so state when they arrive.

In general the Japanese women have large families, are able to nurse their babies (as many American women in Hawaii are not), take good care of their children, dress them in American clothes when they begin to go to school, and establish homes that compare favorably with other immigrant people of similar economic and social grade.

Upon comparison with the table of Chinese marriages and intermarriages, given in the Appendix, Tables I and III, it will be noted that there is little tendency on the part of the Japanese to amalgamate with the Hawaiians, whereas the Chinese have contributed largely to the formation of the Chinese-Caucasian-Hawaiian mixture. Neither do the Japanese marry as freely with the Portuguese as the Chinese have done.

THE KOREANS

The importation and immigration of foreign-born Koreans into Hawaii up to 1910 has been as follows:

Previous to 1901	65
1901–1904	3360
1905	590
1906–1910	145

There are now about 5,000 Koreans in Hawaii, mostly alien males. During the five-year period, 1913–1917, 404 Korean men married and 311 Korean women married. It is noteworthy and most extraordinary that all of the women, without exception, married Korean men. The women of *no other race* in Hawaii have a like record for tenacious adherence to racial lines. The women of no other race have married only men of their own race. The Korean men have "out-married" to a considerable degree, as witnessed by the tables (see Appendix, table V):

CONCLUSIONS

In general, Japanese marry only Japanese; they show remarkable racial allegiance, more so, as a race, than any other in Hawaii. A few Japanese men have married Hawaiian, part-Hawaiian, and Portuguese women; only one has married an American woman. There are surprising few marriages between the Japanese and the other Asiatic peoples in Hawaii; a few Japanese women have been married by Chinese and Koreans. In general, Asiatics in Hawaii breed more freely with Caucasian stock than they do among themselves. All the Korean women have married only Koreans. The Korean men have married not only Koreans but also women of Hawaiian and part-Hawaiian blood.

The Japanese and Koreans contrast strongly with the Chinese in race mixtures, the former groups evincing strong clannishness in marital selections: the latter groups freely breeding "out."

APPENDIX

Race Mixture in Hawaii

(See article on page 41)

Table I shows the racial elements involved in all Chinese marriages in Hawaii during 1913-1917:

TABLE I

Nationality of mate—wife or husband	Chinese		Chinese-Hawaiian		Chinese-Portuguese	
	Men	Women	Men	Women	Men	Women
Total marriages	613	382	173	240	5	5
Chinese	359	359	7	59	0	0
Chinese-Hawaiian	59	7	27	27	0	0
Chinese-Filipino	1	0	0	0	0	0
Chinese-Japanese	1	0	0	0	0	0
Japanese	4	2	0	1	0	0
Jap-Hawaiian	0	1	0	1	0	0
Korean	0	1	0	5	0	0
Korean-Hawaiian	0	0	0	1	0	0
Filipino	1	0	0	4	0	0
Hawaiian	140	4	82	72	0	1
Caucasian-Hawaiian	27	1	47	36	1	1
Spanish	1	0	0	0	1	0
Portuguese	11	0	8	15	2	1
Porto Rican	7	0	0	0	0	0
Norwegian-Portuguese	0		0	0	1	0
American	1	6	0	15	0	0
British	0	0	0	0	0	1
Swede	0	0	0	0	0	1
Russian	1	0	1	0	0	0
Austrian-German	0	1	0	2	0	0

One marriage of Chinese-Hawaiian man with Chinese-Japanese woman.
One marriage of American man with Chinese-American woman.

Table II shows graphically, so far as records are available, the relation of Japanese to the population as a whole:

Table II

Year	Total population	Japanese	Born in Japan	Born in Hawaii
1860	67,000			
1866	63,000			
1868	...	148	148	
1872	56,900			
1878	58,000			
1882	73,000			
1884	76,000	116		
1889	...	8,400		
1890	95,246	12,360	...	902
1896	109,020	24,407	...	2,078
1899	134,953	42,376		
1900	154,001	61,111	56,230	4,881
1908	172,000	72,000		
1909	175,000	75,000		
1910	191,909	79,674	59,785	19,889
1911	200,000	80,000		
1912	210,000	80,366		
1913	217,744	83,100		
1914	227,391	89,715		
1915	231,210	91,490		
1916	237,623	97,000		
1917	250,627	102,479	...	30,000 (estimated)

Table III shows the marital relations of the Japanese in Hawaii:

Table III

Year	*Males*	*Females*	*Males to* 100 *females*
1890	10,079	2,281	490
1900	47,508	13,603	349
1910	54,783	24,891	220
1918 (estimated)	62,000	40,000	155

It will be noted that during this period, 1890-1918, the number of males has increased 500%, the number of females 3,800%; there is still a large disparity between numbers of males and females.

Table IV shows the racial elements involved in all Japanese marriages in Hawaii during the five-year period 1913-1917. Accurate data are not available for earlier years, but the essential facts would be substantially the same for a longer period. The data are from the official record of the Territorial Board of Health:

TABLE IV

Nationality of mate	Japanese		Jap-Hawaiian		Jap-Portuguese	
	Men	Women	Men	Women	Men	Women
Total marriages	7,671	7,647	8	2	1	3
Japanese	7,627	7,627	0	0	0	1
Jap-Portuguese	1	0	0	0	1	0
Chinese	2	4	1	0	0	0
Korean	0	5	0	0	0	1
Filipino	0	1	0	0	0	0
Hawaiian	27	2	3	0	0	0
Chinese-Hawaiian	1	0	1	0	0	0
Caucasian-Hawaiian	4	2	3	1	0	0
Portuguese	8	0	0	1	0	1
Spanish	0	1	0	0	0	0
American	1	2	0	0	0	0
British	0	1	0	0	0	0

One American man married a German-Japanese woman.

TABLE V

Nationality of wife	*Korean men*
Korean	311
Japanese	5
Chinese	1
Filipino	3
Hawaiian	52
Chinese-Hawaiian	5
Caucasian-Hawaiian	2
Portuguese	9
Spanish	10
Porto Rican	2
German	1

One Korean-Hawaiian man married a Chinese-Hawaiian woman.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, April 5, 1919.

WILD WHEAT FROM PALESTINE AND NEW HYBRID

Here is shown a spikelet of the true wild wheat and one of the hybrid forms. (Frontispiece.)

THE SYNTHETIC PRODUCTION OF WILD WHEAT FORMS[1]

H. H. Love and W. T. Craig[2]

The rediscovery of wild wheat or wild emmer in Palestine by Aaron Aaronsohn[3] is of great interest to those investigators who are concerning themselves with work in cereals, particularly with wheat. It also is of general interest, since any evidence that may be produced to connect domestic varieties with their wild prototypes is always of interest.

Körnicke found in the National Museum of Vienna some Hordeum spontaneum which Kotschy had gathered at Rasheyya, Palestine, on the northwestern side of Mount Hermon about 1855. Among the stems of this material was part of an ear which Körnicke considered to be wild wheat and later named it *Triticum vulgare dicoccoides* and declared it to be the prototype of the cultivated wheats.

No further information was obtained, and no more material of this wild type was found until Aaronsohn in 1906 found a plant at Rosh Pinar in Palestine. Later in the same year near Rasheyya, Palestine, he found many plants of wild wheat in the uncultivated fields. He found a great diversity of forms such as black-glumed types, pubescent forms and other variations. No forms were found which Aaronsohn believed were hybrids between the wild type and the cultivated forms. This wild type came to be named *Triticum dicoccum dicoccoides*, but Cook[4] has suggested the name *Triticum hermonis*, due to its being found on and near Mount Hermon.

The wild wheat was usually associated with wild barley and was found in other places in Palestine by Aaronsohn on other botanical explorations. Aaronsohn stated that this wild form is either the prototype of cultivated wheats or one of the oldest forms derived from such a prototype.

During 1910, Cook, in connection with an investigation of cotton culture in Egypt, visited the wild wheat country in Palestine. The results of this inspection have been fully described.[4] Cook gives a very complete description of this wild form and a number of its variations as found in Palestine, as well as its adaptation to cross fertilization.

In regard to this being the wild prototype Cook says: "Though there is no reason for any further doubt of the existence of a wild type of wheat in Palestine, equal certainty cannot be claimed for the idea that the Palestine wild wheat is the ancester or true prototype of the domesticated types of wheat. It is still doubtful whether all the cultivated types of wheat arose from a single wild species or from different species. Though the wild wheat of Palestine possesses all the characters that the European specialists expected to find in the primitive ancestor or prototype of the domestic wheat, these characters might also be expected to occur in any wild relative of the wheat plant and do not afford ground for a final conclusion regarding the relationships that exist between the wild wheat of Palestine and the domesticated cereals."

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[1]Paper No. 75 of the Department of Plant Breeding, Cornell University, Ithaca, N. Y.

[2]In cooperation with the Office of Cereal Investigations, U. S. Department of Agriculture.

[3]Aaronsohn, Aaron: "Agricultural and Botanical Explorations in Palestine. U. S. Department of Agriculture, Bureau of Plant Industry Bull. 180 (1910).

[4]Cook, O. F.: "Wild Wheat in Palestine." U. S. Department of Agriculture, Bureau of Plant Industry Bull. 274 (1913).

EARLY RED CHIEF AND MAROUANI CROSS

Heads of the parent forms and the F_1 hybrid. The parents are designated by x and y and the hybrid by a. (Fig. 1.)

SECOND GENERATION

The second generation was grown in the greenhouse. 113 plants resulted. Among these plants various forms were produced, as is usual among crosses between common and durum wheat. Note 112, which is the form which produced wild types. (Fig. 2.)

This wild type has a brittle rachis as has wild barley. The rachis is not merely brittle in the sense that it breaks easily as does that of emmer or spelt, but it has a special articulation that permits the joints to separate at maturity. These joints are firmly attached to the spikelets so that they serve as a beak for the latter. Along the sides of the joints are stiff bristles or hairs which increase toward the upper end of the joint.

The glumes of the wild wheat are very stiff, thus holding the grains very tight so that they are threshed with difficulty. These are some of the main differences between the head of the wild wheat and that of common wheat. The plant of the wild wheat is different from that of the common wheat, the stems being finer and the leaves narrower. The foliage is of a lighter green color than ordinary wheat. An illustration of the wild type of spikelet is shown in the frontispiece.

MATERIAL

While engaged in studying inheritance in wheat from various crosses our attention was attracted particularly to one, a species of cross between varieties of the common and durum types. From this cross, forms resembling the wild type were obtained among the segregates in F_2.

This cross is one made between *T. vulgare* var. Early Red Chief and *T. durum* var. Marouani. The Early Red Chief variety was a typical *T. vulgare* form, was beardless, had smooth brown chaff and a red kernel. The Marouani was a typical durum form, was bearded, had a smooth white or yellowish-white chaff and yellow or yellowish-white kernel, which for this study can be considered colorless. C. R. Ball, who has examined this type, says that it is more like an intermediate between Pelessier and Marouani. The sort used had black awns which, according to Ball, the true Marouani does not have. At the base of the spikelet of the Marouani are a few hairs or bristles.

The F_1 type produced from this cross was intermediate in regard to certain characters. There were a few very short beards at the tip of the head which had some black coloration, but were not nearly so black as those of the Marouani parent. The glumes were longer and stiffer than in the female parent, but not so long as in the male. They were pointed at the tip more like the Marouani variety. The kernel was somewhat longer than that of the female parent and was red in color. On the joints of the rachis are a few very short bristles or hairs.

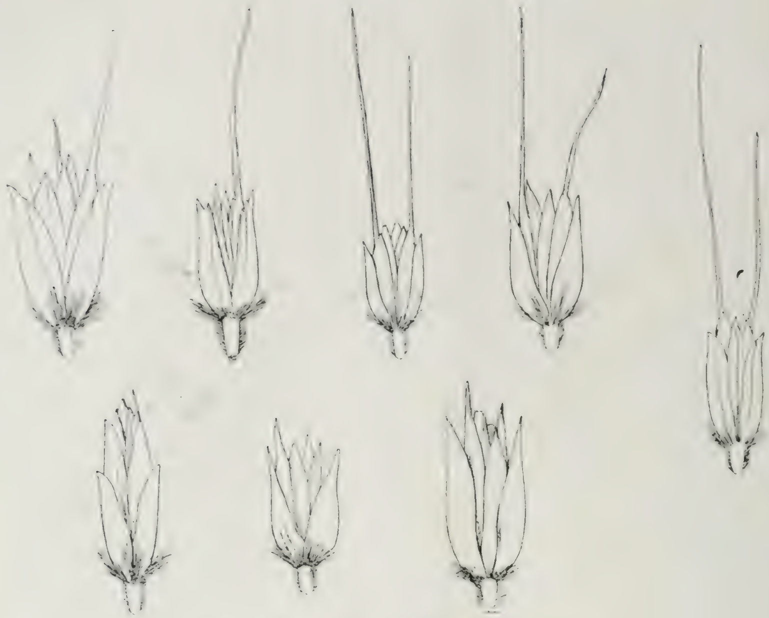
The parent types and F_1 are shown in Fig. 1. The F_1 type is the form shown between the two parent forms.

The second generation was grown in the greenhouse and 113 plants resulted. Among these plants various forms were produced, as is usual among crosses between common and durum wheats. Some of these forms are shown in Fig. 2. While it is not planned in this paper to discuss fully the results as to different forms and characters, a short statement regarding some of the results may be of interest.

In regard to the color of chaff there were in this generation 107 brown chaff to 6 white chaff plants, thus indicating a 15:1 ratio. The color of kernel was noted on all plants that produced kernels and these gave 77 red:5 white kernels. This would indicate a 15:1 ratio for the color of kernel also. In regard to awns there were 83 awnless:30 fully awned plants, which indicates that the awned condition is recessive and inherited on a 3:1 basis. It is well to state, however, that among the 83 plants designated as awnless there are some with a few very long awns on some of the spikelets. The fully awned plants are those that possess awns like the ordinary varieties of awned wheat, while some of the awnless plants with long awns have them only at the tip. One plant in particular had awns developed at the tip of the spike only, yet they measured 10.8 cm. in length, while the longest awns found on any of the plants were only 13.7 cm.

THIRD GENERATION

No. 112 shown in Fig. 2 resembled the wild type. Seeds were sown from this to grow an F_3. Some of the results are here shown. (Fig. 3.)



SPIKELETS IN THE THIRD GENERATION

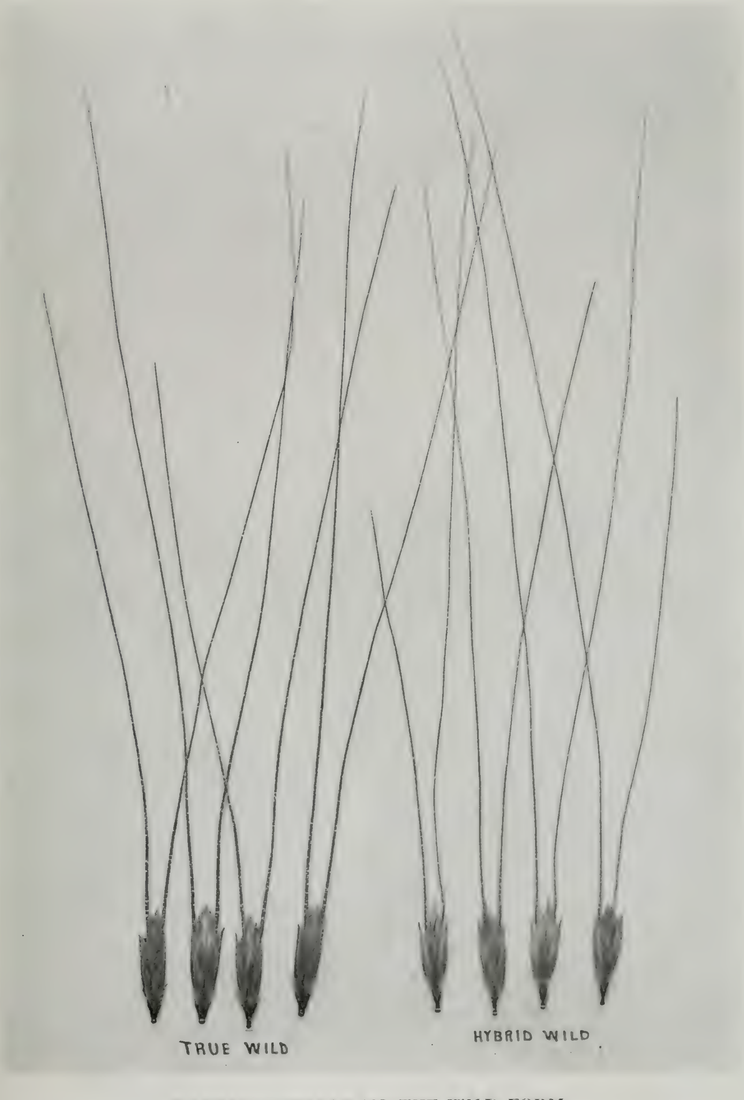
Spikelets from different F_3 plants produced from 112 and 113. Drawings made by C. W. Redwood. (Fig. 4.)

in length. It is of interest to state in this connection that certain families in later generations bred true to the condition where awns were developed at the tip of the head only. These awns developed a length, however, equal to that of fully awned plants. Of the 30 awned plants only 6 developed black color like the Marouani variety. More data are being obtained, however, on this character.

The shape of the glume, that is, whether pointed at the tip or having a shoulder, segregated into 82 pointed glumes: 28 non-pointed.

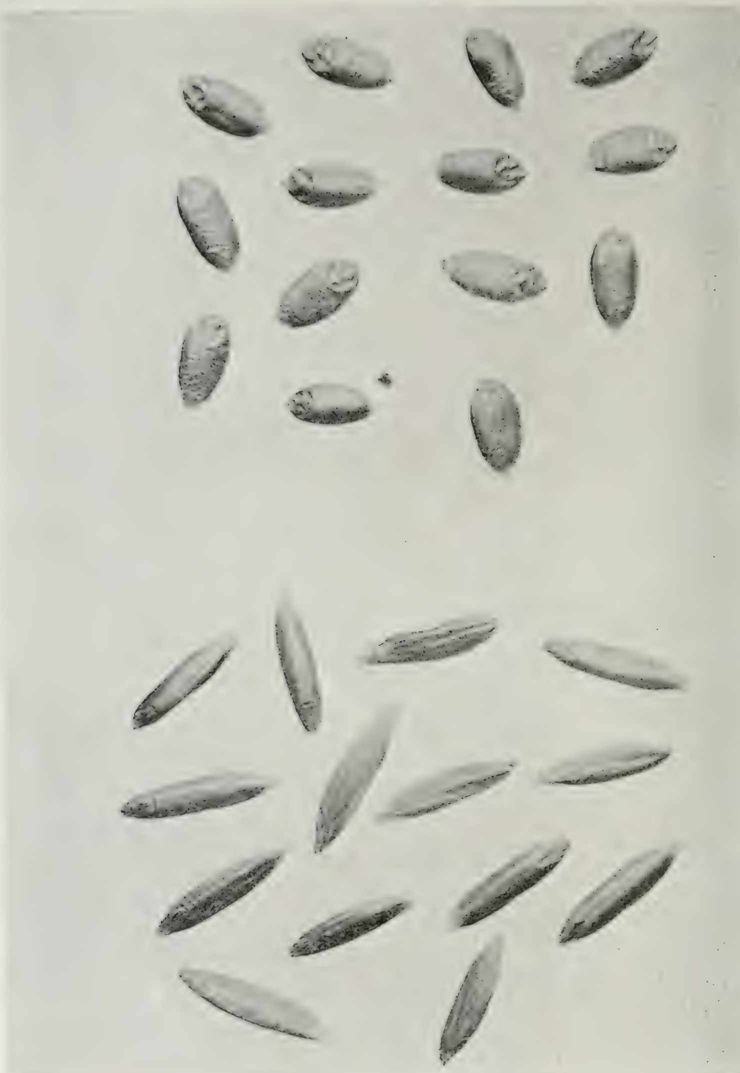
Many of these F_2 plants were tested in F_3. Owing to a poor stand, however, not enough plants were obtained in all families to determine the inheritance of the various characters. In general, however, the results of the third generation agree with the conclusions drawn from the material of the second generation.

Among the F_2 plants were two (Nos. 112 and 113) which are of particular interest in relation to the wild prototype question, and it is a description of these and their progeny which we will now consider. These two plants were in many respects similar to the wild wheat. They both possessed the brittle rachis and long basal hairs or bristles. One form was beardless, while the other was partially bearded. The kernels were longer than in the other segregates and resembled the wild type. The heads were flat, similar to the true wild form. One of these forms, No. 112, is shown in Fig. 2. The one main difference between the true wild wheat and these segregates was that the spikelets of the segregates were somewhat broader than those of the wild type.



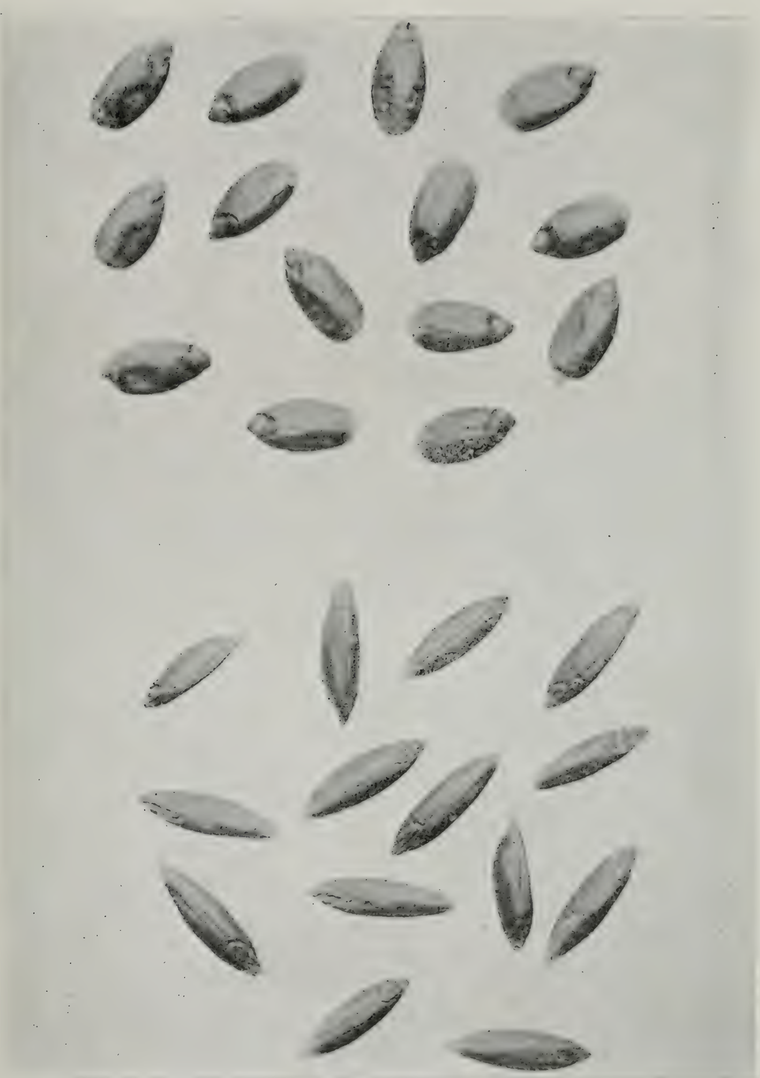
HYBRIDS SIMILAR TO THE WILD FORM

One pedigree produced hybrids very similar to the true wild type. Spikelets of true wild and hybrid type are here shown. (Fig. 5.)



KERNELS OF PARENT AND TRUE WILD TYPES

Upper kernels, female, of parent type. Lower kernels are the true wild types. The kernels of the synthetic wild type, shown on the opposite page, may be somewhat more plump than those of the true wild, yet many of these are actually identical in all respects. (Fig. 6.)



KERNELS OF PARENT AND SYNTHETIC WILD

Upper kernels, male of parent type. Lower kernels are of the synthetic wild, which so strongly resembles the true wild. (Fig. 7.)

Each spikelet, however, carried away the joint of the rachis attached to it just as does the true wild wheat.

At first thought it may be suggested that these two forms arose because of a natural cross with the F_1 plant and the wild wheat. Such is not a possibility, however, since no wild wheat had been grown in any of our cultures until the year the F_2 was grown, and then these plants were in a distant part of the greenhouse.

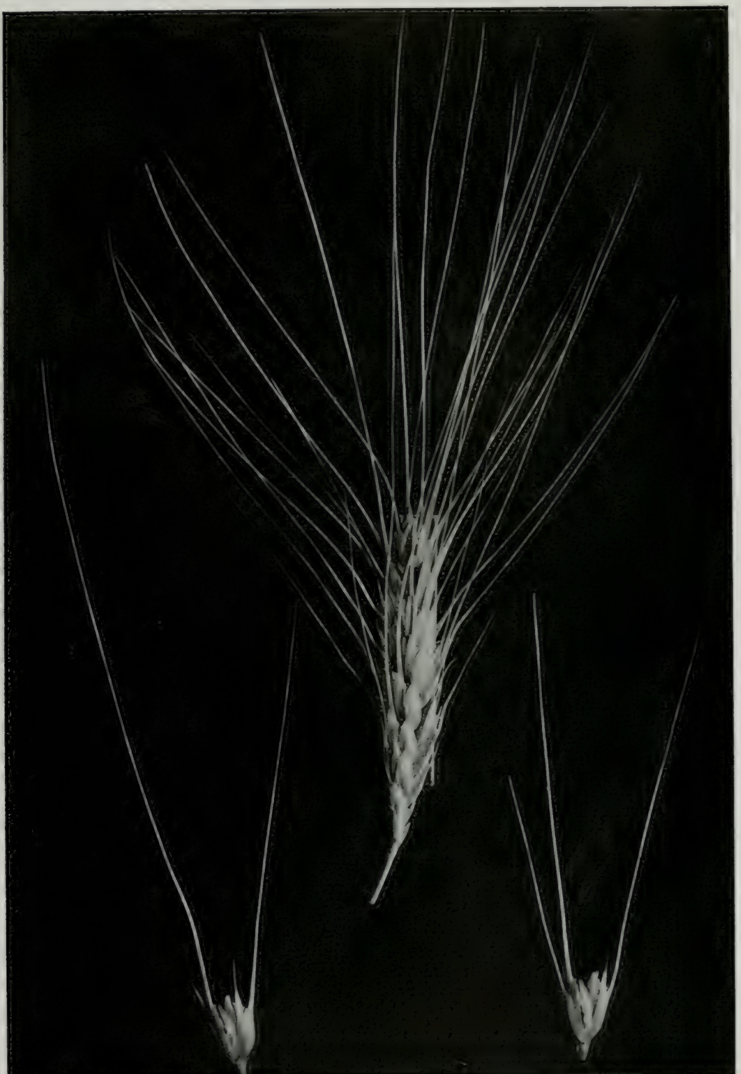
Seed from both plants Nos. 112 and 113 were sown to grow an F_3 and produced some very interesting forms. Some of these forms obtained from No. 112 are shown in Fig. 3. Plant 112 produced enough seed so that 70 plants were grown in F_3. They segregated for various characters such as color of chaff, awns, and the like.

In regard to color of chaff a segregation of 52 brown: 18 white chaff was obtained. Awnless, intermediate, and awned plants were obtained as follows: 18: 38: 14. A great many of the spikes were flat, much like the spike of the wild type. There was a tendency on the part of many plants to produce compact-like heads. Most of these were flattened, but not of the true wild type of head. All of the plants possessed the long basal bristles similar in length and amount to those borne by the wild sort. All kernels were red, and very many of them similar in shape and length to the wild type of kernel. Finally, in regard to the fragile rachis, most of the plants produced heads with a fragile rachis. There was considerable variation with respect to this character. Some of the spikelets separated at maturity, thus making it difficult to harvest them, while others would not separate until they were being handled. Some were in all respects as fragile as the wild form. Only 5 or 6 plants had a somewhat solid rachis. Certain of the spikelets obtained in this F_3 are shown in Fig. 4. While there is some variation in regard to size, shape, and the like, all are similar in that they carry with them the joint of the rachis, which has a duck-bill appearance.

Only 10 plants were obtained in F_3 from plant 113. In general, their behavior was similar to that of the segregates from plant 112. Some of the plants from F_3 were tested again in F_4. The results as obtained, so far as the character of brittle rachis is concerned, showed that practically all of the plants produced heads with the brittle rachis. There was some variation, yet most of them were brittle. Only 3 plants produced heads that broke apart with difficulty. All of the plants produced red kernels and the long basal bristles. Most of the plants produced their spikes on straw which was solid for some distance below the first joint of the spike. A number of the kernel shapes were very similar; in fact some were identical with the wild. The plants produced from pedigree 2030a1-112-7 were very similar in all respects to wild, as will be seen from inspection of Fig. 5, since one of these segregates is shown with the true wild type. It may seem that the awns of the wild type are heavier than the wild segregate. However, other forms have been obtained with awns as heavy as the wild. In addition to the characters of the spike being similar to those of the wild wheat, the habit and appearance of the plants also were similar to the wild type. The plants had fine stems and leaves and the color was of a lighter green than is common among the domestic wheats.

Seed from certain of these F_4 plants were sown and another generation was grown. The results of this planting were very similar to those of F_4, thus indicating that the plants all bred true to the character of the fragile rachis. Some of the families produced were like the wild in all of their characters. This is particularly true with respect to two families. In family 112-4-4 the rachis was very fragile and, although there was segregation regarding awns the awned types were very much like the wild wheat.

The offspring of 2030a1-112-7 were all classed as wild types in the fifth generation, so there is no question of doubt but that types in every way similar to



REVERSED AWNS

The awns of wheat when present are ordinarily grown on the flowering glume, not on the the empty glumes. The empty glumes may bear a short beak. (Fig. 8.)

the wild wheat have been produced synthetically. The spikelets of these individuals are represented together with the true wild in Fig. 5. The kernel types of the parent varieties and those of the true wild and synthetic wild are shown in Figs. 6 and 7. The kernels of the synthetic type may be somewhat more plump than those of the true wild, yet many of these are actually identical in all respects.

REVERSED AWNS

Another very interesting fact observed in this cross was that of the reversed awn condition. The awns of wheat, when present, are borne by the flowering glumes. The empty glumes may bear a short beak and in some sorts this beak may develop a length of at least 1 cm.

Among the segregates of 112 were found some types on which the awn was produced on the empty glume and the beak on the flowering glume (Figs. 8 and 9). All of the awns were not thus reversed, but usually one on a spikelet. Sometimes the awn and beak were nearly of the same length, when again the beak on the flowering glume would be no longer than the beak usually borne on the empty glumes. While studying thousands of wheat segregates, this character has never been observed in any other cross.

Seed from certain of these reversed awn types have been sown, and it is found that the abnormality is reproduced in the following generation. In fact, one family at least gives every indication that it is homozygous for the reversed awn, as all of the plants in the family of the fifth generation have this condition.

Crosses between types with the reversed awn and the ordinary types have not been made as yet to determine the behavior of this character in crossing, but it is planned to make such crosses.

BEHAVIOR OF WILD WHEAT IN CROSSES

While studying the wild segregates it was considered necessary to determine how the characters of the true wild wheat were inherited when crossed with other types. Two such crosses have so far been observed. One durum variety, Gharnovka, and one common variety, Extra Early Windsor, were each crossed with the wild wheat. It is not planned to give these results here in detail. A few facts, however, will show the inheritance of certain characters.

In the F_1 the brittle rachis is dominant, or partially so, over the solid or ordinary type of rachis. On the joints of the rachis are many basal hairs or bristles. The spikelets look much like those of the wild type, except that they are broader.

When the F_2 is inspected it is clear that the fragile rachis segregates, at least in these crosses, on what seems to be a 3:1 ratio. Types are obtained which resemble the wild type used as a parent. These have the flattened heads, long, stiff glumes, basal bristles and long kernels like the wild type. The red kernel color of the wild type seems to be the resultant of two factors according to the ratios obtained.

It is clear from these crosses that the wild type is obtained as a segregate in the F_2 and succeeding generations, thus adding further evidence that, had it been possible for the wild types obtained from the Early Red Chief-Marouani cross to have been the result of a natural cross, further segregations would have been obtained in the following generation. It is clear also that the characters of the wild wheat behave in hybridization much as do the characters of the other wheat types.

GENERAL DISCUSSION

The occurrence of this wild form is a cross between the common and durum types is of considerable interest, since it may throw some light on the question as to the prototype of our common wheats. Since in the second generation there were two wild-like plants found out of a total of 113, it might be assumed that they occur as a natural result of ordinary segregation, and, occurring in this proportion, might indicate a 63:1 ratio. If this were true,

REVERSED AWNS

Among the descendants of 112 shown in Fig. 2 some of the segregated types are here shown with reversed awns. Generally all of the awns were not reversed, but usually one on a spikelet. (Fig. 9.)

one would expect that in F_3 certain families would be found which would produce more of the wild types. Only one such family was obtained, however. Owing to the fact that there was a poor stand in F_3 due to a heavy rain just after sowing, it cannot be said definitely that more families did not exist which may have produced wild forms if a full stand had been obtained. It seems, however, that enough plants were obtained so that, if as many families produced, or would have produced, wild plants as expected in F_3, a number of wild plants would have been obtained in this generation. More evidence on this point cannot be obtained until this cross is repeated, which is now being done.

The occurrence of these forms may lead to the conclusion that the wild wheat of Palestine is the prototype of our domestic wheats and that the factor or factors necessary to its production were carried by either of the parent forms and that through some fortunate combination of factors the wild types were produced. If this were true, then is it not possible that many varieties may carry these factors and that through crossing these the wild wheat forms would be produced? Such does not occur, however, for in several hundred different wheat crosses under our observation no such wild types have been produced except those in the one cross discussed. These combinations include crosses between the emmers, spelts, durums, clubs, and common wheat.

It is possible that these forms may have occurred through mutative changes so far as the factors for the production of type of rachis, basal hairs, shape of kernel and the like. It has been noted that there were segregations in F_4 and F_5 regarding awns, so that if a mutation did occur it was not one affecting all the characters but only those mentioned. If it is later evident that these types have arisen through mutation, it will be interesting, since it will be the origin of a type with dominant characters. Such cases are rather rare.

Since these wild-like forms have occurred through crossing it does *not* follow that the wild wheat of Palestine is certainly a prototype of the common wheat. For, as suggested above, we might expect such occurrences more commonly. For example, in Avena crosses the wild *A. fatua* is not produced commonly, if ever, when crosses between different types of oats are made,[6] even though the varieties of *A. sativa* are thought to have been deived from *A. fatua*.

From the evidence one might well put forth the suggestion that the wild wheat of Palestine may have been produced originally through a natural cross. Owing to its very excellent adaptations for self-dissemination it would naturally spread and fill up waste places. The wild oat of the west is more common in waste places than in cultivated fields. It occurs in cultivated fields but, owing to cultivation, is not so common. Wild wheat, then, may even exist occasionally, though unnoticed, in cultivated fields.

The occurrence of wild segregates in the cross described does not prove that the wild wheat is the prototype of wheat, but rather raises the question whether it really is a protoype or a contemporary form. More data from other crosses will be needed before any definite statement can be made. May it not be possible that there is a certain type (or types) in Palestine that, when crossed with others, may frequently produce the wild type?

CONCLUSION

A wild type of wheat was produced by crossing a durum with a common wheat.

This type of segregates from this type was similar in all respects to the typical wild wheat of Palestine.

The occurrence of this wild form may be evidence in favor of the prototype theory in relation to the wild wheat of Palestine or indicate that such a wild form may have arisen through natural crossing between already existing forms.

[6] The authors have some evidence that such may be produced in certain crosses.

PRESENT CONDITION AND OPPORTUNITY OF THE AMERICAN GENETIC ASSOCIATION[1]

David Fairchild

THE YEAR which has passed since our last meeting is one of the most remarkable in the history of mankind. Through the whirl of terrific forces which has characterized it I feel sure all of us must see a drift that threatens many or all of the familiar adjustments of human society. Whether we understand that drift or not, we must recognize that it is fraught with the most sinister possibilities. The rupture of the fabric of society, which we have seen going on around us and read of as an overwhelming catastrophe in Russia and as threatening all Europe, we must begin to consider as a phenomenon based upon the rapid spread of propaganda which is as unsound biologically from the standpoint of this new science of genetics as the theory of the flat earth was unsound physically. In becoming more scientific, in the sense of being more open-minded and accessible to new ideas, the world has become more susceptible to destructive as well as to constructive suggestions, and since it is vastly easier to detroy what now exists than to develop and apply constructive solutions of our problems, the dangers of the present situation are hardly to be exaggerated.

All of these burning questions of the day, which are stirring men's hearts and angering or saddening them, must have answers based upon principles. What are these principles? It is likely that they will ever be revealed through the discussion and deductive reasoning of men like the bolshevik leaders of Russia? Have we not witnessed long enough the steady growth of the exact sciences to feel convinced that there is no other method by which the human mind can arrive at stable notions of things than through the methods of experiment and objective observation? There is no short cut—no inspiration based upon ignorance of what has gone before.

The spectacle of the influence of a single abnormal personality upon a nation of sixty millions and of our own concentration of authority in the hands of the President as the only means of meeting a real crisis should make us realize, as never before, the paramount importance of the individual, as a focus or nucleus bearing the fate of an entire nation or race. The weak personality of the Tzar, and the absolute chaos for lack of strong leaders after his destruction, form a picture which is terrible to contemplate.

The spread of personal propaganda, and by this I mean the systematic propaganda which attracts and rivets the minds of millions upon the personality of some public official, has developed since the war began to proportions undreamed of before, and this phenomenon is one which deserves the closest scrutiny. The formation of convenient brain patterns in the form of slogans and their use by those who declare in a loud voice that they see confidently into the future, but whose theories are false for all their assumption of superior knowledge, will force upon the scientific community, who are the real intellectuals of the world, the necessity of some adequate counter-propaganda in which the factors of human welfare, as shown by the science of inheritance, will be driven home and sink deep into the consciousnesses of great mass of the people.

If the false doctrines that threaten

[1] President's address delivered before the Annual Meeting of the American Genetic Association, Washington, D. C., January 9, 1919.

to destroy society as a living organism and replace it with an arbitrary and artificial system directed from below by the less intelligent elements of the population should prevail, an era of extreme depression and chaos might easily come upon us, a period of disintegration and decay like that of the Roman Empire and the dark ages that followed the complete overturning of society. Think of the Spanish Inquisition from the standpoint of propaganda. Recall how it swept over and blasted a capable and rapidly developing nation and ran into other countries like an epidemic. Can we be confident that those who think they can control public opinion know what they are doing—especially when we see erroneous ideas and misstatements of fact in this torrent of propaganda? As scientific men we know more facts and see the drift of many things, but our honesty, and especially our repugnance towards self advertising, prevents us from taking the place which we ought to take in the councils of the people. We cannot reach them with our scientific jargon, and our desire to be true to the cult of our science and to stand well with our professional colleagues keeps us from popularizing our ideas and thus exerting at least a fraction of the influence which is our right and our responsibility as students of these tremendous problems.

We are here as members of the American Genetic Association, an association of scientific men and of those who are interested in the great subject of heredity and its relation to human welfare. And we are citizens of a country which stands before the world as no country before has stood. The times are fraught with the greatest dangers, and these dangers lie in the realm of the understanding and are based upon certain laws of inheritance, which we are investigating. One of the greatest tools which can be used to educate the public is the tool of illustration. The most prominent feature in the propaganda program is the use of striking pictures, pictures which really tell a story; pictures which have been prepared for the express purpose of producing a certain effect. You all know, as well as I do, that we have the materials, and what we should do is to use them for the enlightenment of a widening audience of the most intelligent people of the country.

The situation, as I see it, constitutes one of the greatest opportuniies of our lives, and I cannot overemphasize my feelings in the matter, for they amount to conviction. If we handle the situation at this time, we will do a great service to the world. If we do not, we fail, and a great opportunity passes. While we delay or hesitate, other organizations, with more obvious but less important appeals to the intelligence of the people, are forging ahead with evanescent, distorted and moral-destroying propaganda.

Our propaganda should be against the almost universal fallacy which pervades society ideas everywhere that acquired characters are somehow and in some mysterious way inherited. The non-inheritance of acquired characters is a well-established theory, but the general public does not know it. Through the educational propaganda, through the charitable propaganda, through the sporting propaganda and through the medical propaganda there runs everywhere the unspoken assumption that, given a good environment, any child is as likely to be great as any other; and everywhere we find people who are searching for all of the causes of crime and degeneracy in the environment. The wayward son of the preacher, the deaf from childhood, the small-sized boys of small parents who "never got enough to eat when they were young," the effect of hats as causes of baldness, the causes of longevity, and a host of others are now "explained" by those who do not know. Millions of dollars are expended every year upon palliative remedies with the firm conviction of the givers that they are curative measures, whereas they end with the generation they assist.

If through the propaganda of this little Journal of the Association we could get a hundred thousand people to

thinking regarding the real difference between the phenomena of environment as distinguished from those of heredity, the accomplishment would be a great positive gain to our country.

These differences can only be learned through study. They cannot be taught like so many of the superficial facts of the advertising business by the diagrams or pictures of a single poster.

The background of plants and animals and their behavior must be presented and the mind led up to the great fact of heredity by a series of steps which requires many pictures and illustrations to make clear.

It is hard for the layman to believe that you can cut off the tail of a white mouse and its daughter and her daughter and all the daughters for a hundred generations and of the sons as well without producing a tailless breed of white mice, whereas, if you hunt the world over, you will probably find somewhere a pair of mice which were born without tails and, by breeding these together and selecting the tailless ones and mating these again, produce in a few generations a breed of tailless white mice. A variety of spineless cactus cannot be produced by rubbing off the spines and making cuttings from the spineless portion. Identical twins often remain through life so much alike that they are mistaken for each other, whether they have lived in the same environment, or have led the same kind of life or not.

It is the propaganda for an understanding, a universal study of the great forces which we know are here, that our journal should undertake, and the first great work lies in the elucidation of the fundamental difference which exists between the changes wrought by our environment and the limitations which come through our heredity. What experience can be more bitter than that of offering all the possibilities of the widest imaginable environment to a youth only to find that he does not want them, that he simply cannot rise to their utilizaion. "He could if he would only try," sums up too often a case of defective inheritance. But these I know are too complicated matters to be carelessly answered in this way. They present the most difficult problems in this new science. They are in the very field which the JOURNAL must enter with its propaganda, viz., the field of the inheritance of *mental* and *moral* characteristics, in which field the evidence is rapidly accumulating, making it more and more certain that they *are* inherited and are scarcely more easily changed than a child who is slow at figures can be made into a great mathematician or one who cannot carry a tune can be developed into a great composer.

Preparing for Great Food-Raising Tasks of "After the War"

"Strengthen agriculture's organizations for 1919."

This slogan has gone from Washington to every State—in preparation for the huge after-war tasks of American farmers—and reports of responses in every section of the country now are coming to the United States Department of Agriculture.

Tens of thousands of farmers are joining and making stronger the county councils of agriculture, county farm bureaus, and other local extension organizations that have come to hold a place of vital importance in the organized agriculture of America.

These local organizations of farmers occupy much the same relation to the counties as chambers of commerce occupy to cities. They plan for prosperous and balanced agriculture, introduce better farming methods, work for more and wider markets. They deal especially with the work of the coöperative agricultural extension agencies, and are not intended to take the place of the existing farmers' organizations, with which they sustain many helpful and cordial relationships.—*Weekly News Letter, U. S. Dept. of Agriculture.*

SOME PRESENT ASPECTS OF IMMIGRATION

Fourth Report of the Committee on Immigration of the American Genetic Association.[1]

THE last Report of the Committee on Immigration was made about one year before this country entered the war.[2] In that report this committee stated its reasons for believing (1) that the war would be followed by a very large increase in the numbers of immigrants, and (2) that the general effect of the war as a whole would probably be to cause a deterioration in the mental, physical and moral characteristic of our future immigants and of their descendants. A summary of the immigration bill then pending in Congress was given, and the committee expressed itself as heartily in favor of all the provisions looking towards the more effective detection, exclusion and deportation of mentally and physically unfit aliens. This bill, after having passed both houses of Congress, was vetoed twice by President Wilson, but was passed over the veto by both Senate and House and became law on February 5, 1917, about one month before this country declared war. The new statute became effective on May 1, 1917. It is by far the most comprehensive immigration legislation ever enacted in this country and, *if properly enforced*, can become of immense benefit to our future race.

The effect of the war in diminishing the volume of immigration to the United States was, of course, expected, but has nevertheless been striking. From an annual immigration of nearly a million and a half during the fiscal years 1913 and 1914, and an annual net increase in alien population (*i. e.,* deducting the numbers of those who returned to their own countries) of 800,000, the number of immigrant aliens fell to a little over 325,000 during the year ending June 30, 1915. In the fiscal years 1916 and 1917, about 300,000 came, while in the year ending June 30 last the number of immigrant aliens was only 110,000. From July to October, 1918, the number of immigrant aliens was 37,410, and of non-immigrant aliens 25,729. While the mere fact of greater or smaller numbers does not, in and for itself, concern this committee, there is a very important aspect of a small immigration which is of the greatest interest to eugenists. It has always been held by those who are concerned regarding the admission into the United States of mentally and physically defective aliens that, with a smaller number of alien arrivals, the work of inspection could be more effectively done, with the inevitable and greatly-to-be-desired result that fewer undesirables would escape detection. Our experience during the war has borne out this view. The last Report of the Commissioner General of Immigration (for the year ending June 30, 1918) gives the following percentages of aliens who were refused admission for all causes: 1914, 2.3%; 1915, 5.3%; 1916, 4.9%; 1917, 4.2%; 1918, 3.3%. The increase in the

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[1] Personnel of Committee: Alexander E. Cance, Amherst, Mass.; Irving Fisher, New Haven, Conn.; Prescott F. Hall, Boston, Mass., Chairman; Dr. Thomas F. Salmon, New York City; Robert De C. Ward, Cambridge, Mass., Secretary.
This report has not been submitted to Professor Cance and to Dr. (now Colonel) Salmon, both of whom are overseas.

[2] See *Journal of Heredity*, vol. vii, No. 6, June, 1916, pp. 243–248.

percentage of rejections during the war is to be ascribed, according to the Commissioner General, to two causes: first, a deterioration in the quality of immigration itself; and second, to the more rigid inspection made possible by the decreased numbers. One of the provisions of the new Immigration Act requires that *two* inspection officers shall, whenever practicable, pass upon the case of each alien, and the same is true of the medical inspection. It is interesting to note that 23% of the total number of all rejections for the year 1918 were due to the operation of new provisions in the Act of February 5, 1917. Among those rejected because of such new provisions there were 20 certified for chronic psychopathic inferiority; 24 chronic alcoholics; 17 afflicted with "tuberculosis in any form" as distinguished from tuberculosis of the respiratory, intestinal or urinary tracts, these being excludable under the old law; 10 aliens mentally defective without regard to the effect of such defect upon the ability to earn a living. In addition to the foregoing, debarred under new provisions, there were debarred under provisions contained in both the old and new laws, 4 idiots, 5 imbeciles, 64 insane, 31 epileptics, and 19 feeble-minded. That even the new law does not accomplish all that is desirable is shown by the fact that, in 1918, out of 6,153 aliens certified by the surgeons as mentally or physically defective, 4,558, or 74.1%, were landed. In 1917, 71.4% were landed.

An excellent provision of the new Immigration Act is the extension of the period during which the expulsion of defective aliens can be accomplished. In the past year 106 aliens suffering from serious mental defects were expelled from the country. Of this number, 17 were so afflicted when they were originally admitted, 78 became insane within five years after landing, and 11 became public charges because of other mental defects. In the previous year, 172 aliens suffering from serious mental defects were expelled. Of these, 38 had been so afflicted at the time of entry and 130 had become public charges within three years after entry because of insanity.

In the last Report of this Committee, attention was called to the great importance of the proposed increase in the fines to be levied on the transportation companies in cases where aliens, clearly excludable under the law, are brought to this country. These increased fines are now embodied in the new Immigration Act. It is obviously a very great hardship on individual aliens who have made the long journey to this country to turn them back at our ports when they are found to belong in the excluded classes. Such cases are often reported in our newspapers, naturally arouse widespread sentimental interest, and usually bring out unreasonable and ill-judged protests against any rigid enforcement of the Immigration Act. Experience has shown that the only way to diminish the number of such cases of hardship is to levy considerable fines upon the steamship companies when they give passage to aliens who, on embarkation, clearly fall into the excluded classes which are named in the law. The new Immigration Act increases the fines in cases where they were already provided and established new fines in other cases. During the past fiscal year, a total of $63,515 was collected in such fines. Of this amount, $7,325 was levied because of the bringing to our ports of mentally or physically diseased aliens. A rigid medical inspection of all arriving aliens, and the collection of fines in all cases where such fines can clearly be imposed would certainly do a very great deal, under the excellent provisions of the present law, to improve the mental and physical qualities of our immigrants. That much more could be done under the administrative fine provisions is shown by the fact that, while 954 aliens were debarred as being physically or mentally diseased or defective, fines were imposed for bringing only 93 of these.

If any further arguments were needed to show the value and importance of

our new Immigration Act, the war has supplied them. This law is our only breakwater against the advancing tide of immigration which, unless all signs fail, is likely to be both increased in quantity and lowered in quality. The new law has not yet stood the test of a large immigration. Everything should be done to secure its effective administration. Its rigid enforcement would unquestionably result in an improvement in the mental and physical qualities of our immigrants even if it was not designed to, and cannot, greatly reduce their numbers.

The almost certain prospect of a greatly increased immigration closely following the ending of the war, the manifest injustice of exposing our returning soldiers and sailors to competition with the low-priced labor of Europe and of Western Asia, and the conviction that our present immigration law is qualitatively selective rather than numerically restrictive have naturally resulted in a widespread demand for immediate further legislation. The Immigration Committee of the House of Representatives has reported a bill (H. R. 15302, Union Calendar No. 359; Report No. 1015) suspending immigration for four years with many exceptions in the cases of certain professional classes; the near relations of aliens now in or citizens of the United States; aliens from Canada, Newfoundland, Cuba and Mexico; aliens who are refugees because of various kinds of persecution, and of aliens admitted temporarily under regulations to be prescribed by the Commissioner General of Immigration with the approval of the Secretary of Labor.

The general economic aspect of the immigration problem does not concern the Committee on Immigration of the American Genetic Association. This committee therefore does not feel called upon to express any opinion as to the merits, or otherwise, of the pending bill. It is, however, convinced that a reduction in the numbers of our immigrants does simplify and render more effective the task of inspection, and therefore leads to the administration of fewer mentally and physically defective aliens. From that point of view, therefore, a considerable restriction, or a temporary suspension, of alien immigration would have highly desirable eugenic results.

Push the Button and Find a Pig

A Litchfield (Conn.) county agent originated an interesting plan for an agricultural survey. If you want to locate a supply of seed corn or oats, a grain binder, a pure-bred bull, or some young pigs in any community in five counties in this State, all you have to do is to walk into the office of the state librarian at Hartford, Conn., run a series of cards through an electric sorting machine, and, presto! you have the information. It may sound a little like the story of Aladdin's lamp, but it is only big business applied to farm affairs under war stress. The Council of Defense took up this plan and offered to back the farm bureaus to the limit in every county in the State. Five of the eight counties began surveys early in March, 1918. Forty questions, under the headings of area, crops harvested in 1917, crops planned to be harvested in 1918, live stock on hand, machinery on hand, and employes were included in the survey, and a corps of volunteer farmer census enumerators got busy. When the survey was completed the farm bureaus had a stack of cards containing minute information as to the resources and needs of every farm. An electric sorting machine was installed in the state library, and any fact disclosed by the survey can be made available by throwing on an electric switch. The survey has been invaluable in helping Connecticut to mobilize her agricultural forces for war needs.—*Weekly News Letter, U. S. Dept. of Agriculture.*

THE BREED IN POULTRY, AND PURE BREEDING[1]

Case in Which a Standard Bred and Supposedly Pure Bred Family Carries Factors Normal to Other Breeds and Without Being Suspected.

William A. Lippincott

IN ATTEMPTING to give a broad answer to the question, "What is a breed of live stock?" in the Journal of Heredity[2] some time ago, Lloyd-Jones fell into a slight error of detail concerning poultry when he remarked, "Of Wyandottes I believe there are about a dozen varieties differing from each other in color, pattern, feathering, or comb shape." As a matter of fact, the varieties of Wyandottes do not differ in either feathering or comb shape. The comb is always rose and the feathering is uniform throughout the breed.

Poultry breeders appear to have been rather more fortunate in arriving at a definite conclusion concerning what constitutes a breed, than have the breeders of some of the larger farm animals. They have defined it as a group of domestic birds closely approaching a certain specific shape. The breed name is the one which identifies any well-defined and recognized type, such as Plymouth Rock, Wyandotte, Leghorn, Brahma, etc., and the birds conforming closely to those shapes are said to be members of those respective breeds. Some varieties within certain breeds apparently have no immediate genetic relationship.

As feathering has very much to do with a bird's shape, it is manifestly impossible for different members of a given breed to differ in feathering beyond a certain quite well-defined limit of variation. These limits are prescribed in "The Standard of Perfection," a book published by The American Poultry Association and recognized generally as the official guide by which poultry is bred and judged. The Wyandotte is, for instance, described as having featherless shanks and toes. A member of this breed carrying so much as one small feather on the shanks or toes is barred from competition in the show-room, and is said to be "disqualified."

The breeds, which are in reality the basis of poultry classification, are, for convenience, both subdivided and grouped. The subdivisions are termed varieties, while the groups are referred to as classes. There are two varietal distinctions, namely, comb shape and color of plumage; either one or both may be present. Thus the Rose Comb Rhode Island Red differs from the Single Comb Rhode Island Red only in comb shape. The White Wyandotte differs from the Buff Wyandotte only in color, while the Single Comb White Leghorn differs from the Rose Comb Brown Leghorn in both comb and color. They are members of the same breed, however, because they approach very closely the same type or shape.

For the more common breeds the class grouping is based on similar general characteristics and place of origin. The Brahma, Cochin, and Langshan, together, comprise the Asiatic class. They have all come to us from or through Asia and are birds of large size, having feathered shanks, frequently becoming broody and laying a dark-brown egg. The Leghorns, Minorcas, Anconas, Andalusians, and Spanish, which comprise

[1]Contribution from the Department of Poultry Husbandry, Kansas Agricultural Experiment Station.

[2]Vol. vi, No. 12, p. 531.

OCCASIONAL SINGLE COMB SEGREGATES

For some years occasional single comb segregates have been noticed in this standard-bred family of White Wyandottes. Any comb other than rose is a disqualification in Wyandottes. (Fig. 10.)

the Mediterranean class, all seem to have originated around the Mediterranean Sea. They are all nervous, active birds, stylish and sprightly in appearance, somewhat lacking in the brooding instinct and are layers of white eggs.

The breeds which comprise the American class are the familiar Plymouth Rock, Wyandotte, and Rhode Island Red, and the less familiar Java, Buckeye, and Dominique. These breeds were developed in America through a judicious blending of Asiatic and Mediterranean blood lines followed by rigid selection. In most characteristics they fall about half-way between the two general types from which they arose.

The grouping of breeds into classes may have no other basis than that of convenience, or as in the case of the "Miscellaneous" class, which is composed of three rather curious breeds, namely, Silkies, Sultans, and Frizzles, because they do not seem to fit anywhere else.

A complete list of chickens, turkeys, ducks, and geese, as recognized by the American Poultry Association and listed in the American Standard of Perfection, includes fifteen classes, sixty breeds, and one hundred and forty-nine varieties. Of these, twelve classes, forty-two breeds, and one hundred and twenty-one varieties are of chickens. There are eleven breeds of ducks, grouped in one class, and subdivided into fifteen varieties. The six breeds of geese are grouped as one class, only one of the breeds having two varieties. Turkeys are all of the same shape and so all along to the same breed, as well as to the same class. The breed is divided into six varieties on the basis of color, there also being in this case size differences between the varieties.

SPLASHED ANDALUSIAN

Splashed Andalusian, male (Kansas 57M). When mated with the White Wyandotte (Fig. 3) she produced four kinds of offspring with regard to color. These are shown in Figs. 13, 14, 15 and 16. (Fig. 11.)

While one of the rules laid down in the constitution (Article XI, Section 1) of the American Poultry Association[3] for the admission of a new breed or variety to the Standard of Perfection is that "it must be able to produce 50 per cent of the specimens reasonably true to the type and characteristics of the breed or variety, as set forth in the (its) proposed standard," as a matter of fact appearance and not pedigree is the criterion of poultry breeding. Very few poultry breeders keep careful and complete breeding records (though happily the number is steadily growing), and there are no official records.

Pen matings of one male and several females of individuals within the various breeds and varieties are usually made from year to year. If a bird is purchasd for breeding purposes, the buyer has only the word of the breeder and the appearance of the bird to assure him that the bird purchased has been bred pure.

As a matter of fact, however, poultry is, in all probability, nearly if not quite as "pure bred" as any other line ot live stock, even though no breeding record, official or private, is kept. The types and colors could hardly be maintained without it. That the fact of

[3]American Standard of Perfection, 1910 edition, p. 328. Published by the American Poultry Association, Mansfield, Ohio.

WHITE WYANDOTTE

White Wyandotte, female (Kansas 2031). Though of a standard-bred family, she carried factors for "blue" and barring. Dam of birds shown in Figs. 13, 14, 15 and 16. (Fig. 12.)

official registry does not preclude impurity for certain characters is witnessed by the occasional appearance of red Berkshire hogs, red Holstein cattle and horned individuals in registered polled breeds of cattle. And it is quite possible that unsuspected factors usually present and considered desirable in some breeds may frequently be present in the germ plasm of others, but with no opportunity for expression.

That the appearance of an individual or even an entire breed may be far from telling what the real hereditary make-up is, is a matter of common observation by investigators. It was shown specifically in the case of poultry some years ago, by Hadley,[4] for the White Leghorn.

He found that many White Leghorns carried factors for both black pigment and barring, the expression of which was masked by the action of a dominant factor for white. It is obviously impossible to state that all White Leghorns carry these factors, but the condition seems to be quite general, as witnessed by reports from several widely separated investigators. So far as I am aware, no attempt has been made to

[4]Bulletins 155 and 161, Rhode Island Agricultural Experiment Station.

BARRED-SPLASHED MALE

Kansas 147E. Four kinds of offspring were produced from the male shown in Fig. 11 and the Female shown in Fig. 12: Barred splashed males; barred blue males, non-barred splashed females, and non-barred blue females. (Fig. 13.)

trace this condition to any particular racial ancestor.

A family of White Wyandottes has recently come under my observation which is interesting from the standpoint of purity of breeding. Members of this family have repeatedly won prizes in the larger shows of Kansas and Missouri and also at the Panama Exposition show, which was one of the largest ever held in this country. As a result they have been held in considerable esteem by Wyandotte breeders of the Southwest.

By way of explanation it may be said that the white of the White Wyandotte is recessive, as noted by Sturtevant,[5] probably being in the first place a white mutation from the pigmented Silver Wyandotte. The Silver Wyandotte is credited by Brown[6] as having been the product of crosses between the Sebright Bantam, from which it inherited its color, the Cochin and Hamburg, and possibly others.

[5]*Journal of Experimental Zoology*, vol. 12, No. 4, pp. 499–518.

[6]"Races of Domestic Poultry," published by Edward Arnold, London, 1906, pp. 155–163

BARRED BLUE MALE

Barred Blue Male (Kansas 98E). Second of the four kinds of offspring produced, (see Fig. 13.) (Fig. 14.)

For some years occasional single comb segregates have been noticed in this family, two of which are shown in Fig. 10. Possibly this has come down from some of the breed's Cochin ancestors.

It was not, however, until several females from this family were crossed with males carrying black pigment during the 1918 breeding season that it was discovered that the family also carried the factor which, acting on black pigment, renders it bluish-grey in appearance as in the Blue Andalusian, and also the sex-linked factor for barring as found in the Barred Plymouth Rock and White Leghorn. Several individuals were found which carried the "blue" factor and one (Legband 2031), whose likeness is shown in Fig. 12, carried factors for both "blue" and barring. Several were also found which carried neither factor. Although as noted above, this family is more or less heterozygous in respect to comb, this particular individual's breeding behavior showed her to be homozygous for the comb character.

When mated with a Splashed Andalusian male (57M, Fig. 11) this female produced four kinds of offspring with regard to color. These were (1) barred

NON-BARRED SPLASHED FEMALE

Non-barred splashed female (Kansas 1672). Third of the four kinds produced by a cross between a splashed Andalusian male and a White Wyandotte female. (Fig. 15.)

splashed males (Fig. 13), (2) barred blue males (Fig. 14), (3) non-barred splashed females (Fig. 15), and (4) non-barred blue females (Fig. 16).

As previously suggested (Lippincott[7]), the splashed Andalusian is homozygous for a dominant factor for black pigment and for another dominant factor which, acting on black pigment, renders it bluish-grey in appearance. It lacks another dominant factor which is present in self blue, self black, and some self white races, which extends black pigment, if present, into all parts of all feathers of the body, giving a self color.

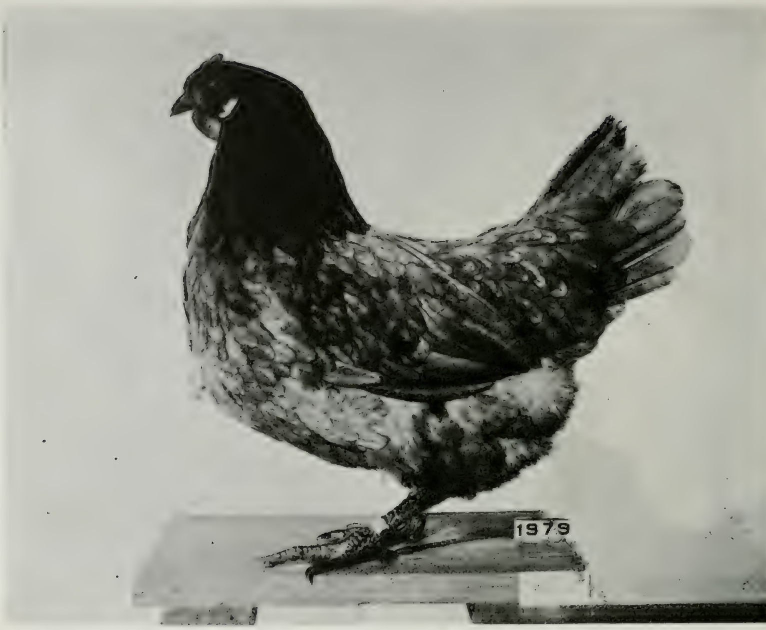
These last two factors may be true allelomorphs (*i. e.*, occupying identical loci of homologous chromosomes) or each may be closely linked to the recessive allelomorph of the other, a point as yet undetermined.

Assuming that the latter is the case, the genetic formula of a splashed Andalusion male, with regard to the characters in question is—

PP (Re)(Re) bb

where P = black pigment
p = white (no pigment)
(Re) = blue in presence of P (self blue if heterozygous [(Re)(rE)], splashed if homozygous [(Re)(Re)]
(rE) = self black if homozygous [(rE)(rE)] In presence of P, blue if heterozygous [(rE)(Re)] in presence of P.
B(sex-linked) = barring in presence of P.
b(sex-linked) = non-barring.
b = indicates lack of synaptic mate of B or b in the female

[7] *The American Naturalist*, vol. lii, No. 614, pp. 95–115.



NON-BARRED BLUE FEMALE

For ancestry, see Figs. 11 and 12. The principal interest in the case illustrated in Figs. 11 to 16 lies in the fact that a standard bred and supposedly pure bred family should carry factors normal to other breeds, and without being suspected. (Fig. 16.)

On the basis of her offspring when mated with a splashed Andalusian male the formula of White Wyandotte 2031 must be, with regard to the same characters—

pp (Re)(rE) Bb

Because this individual does not carry P she is white and neither (Re), (rE), nor B can find expression. However, when mated with a splashed Andalusian the theoretical result is as follows:

Photographs of the four kinds of individuals are shown herewith (Figs. 13, 14, 15 and 16). The expectation of equal numbers of each kind appears to have been closely approximated. The exact numbers are not known, inasmuch as the appearance of barring was entirely unexpected and a number of dead chicks had been counted in the down before the possibility suggested itself that the occipital spot which was appearing on the blue males was the

Splashed And. ♂ 57M
PP (Re)(Re) bb

White Wyandotte ♀ 2031
pp (Re)(rE) Bb

Offspring	(1) Pp (Re)(Re) bB	= Barred splashed ♂ ♂	*M*	
	(2) Pp (Re)(rE) bB	= Barred blue ♂ ♂	*M*	Equal
	(3) Pp (Re)(Re) bb	= Non-barred splashed ♀ ♀	*M*	numbers
	(4) Pp (Re)(rE) bb	= Non-barred blue ♀ ♀	*M*	

juvenile expression of the barring factor, as found in Barred Plymouth Rock chicks.

The principal interest in this case is the fact that a standard red and supposedly pure bred family should carry factors normal to other breeds, and without being suspected. How these factors found their way into the germ plasm is a matter of conjecture. It would appear unlikely that they should have been introduced through any of the known ancestors of the breed, but the history of the formation of the Wyandotte breed appears to be somewhat hazy, and this is a possibility.

There is also the possibility, perhaps the probability, that cross breeding has occurred at some time. The fact that some individuals of this family, and all of the few individuals of other families that have been mated in a similar manner, have not exhibited factors for these foreign characters, seem to favor the latter view. A cross with White Plymouth Rocks at some time in the past might account for both the single combs and the barring, since the latter variety is single combed recessive white and carries barring as a cryptomere. The "blue" factor appears to be more frequent in occurrence in this family than the barring factor. How or when it was introduced one can only guess.

Butter Fat vs. Body Fat

In 1906 a test of soiling crops was made involving the entire dairy herd of The Pennsylvania State College. The crops tested were rye, wheat, alfalfa, timothy and clover, oats, oats and peas, and corn. Among the points under observation were the effects of these various crops on the live weight of the cows, quantity of milk produced, and its fat content. The test involved thirty-one cows and extended from May 17 to August 28. Not all the cows were on test during the entire time, so the total number of observations was 173.

When curves were plotted showing the mean live weight and the mean fat content for the various periods it was found that "A gain in live weight is in every instance accompanied by a decrease in the per cent of butter fat, and a falling off in live weight in every case but one accompanied by a gain in the per cent of butter-fat.

Including the records of 1902 and 1904 with those of 1906, the only years when similar observations were made, it was found that "When the cows gained in live weight their milk fell off in richness and vice versa one hundred and fifty-three times out of two hundred and nineteen or almost exactly 70% of the cases."

At that time no attempt was made to work out the correlation. This has since been worked out and the correlation coefficient between increase or decrease in live weight and increase or decrease in fat content of milk for the 173 measurements of 1906 found to be .47 with a probable error of .039. The values in live weight were taken by 10-pound units and ranged from —40 to 40. The values in fat content were taken by 5% units and ranged from —2 to 2.

While the popular belief has been that cows placing fat on their bodies put less in the pail actual data to confirm it have been comparatively meager. The influence of feed upon fat content of milk has been pretty generally denied, but this test would indicate that some feeds tend to produce body fat while others either directly or indirectly increase the secretion of milk fat.—T. I. Mairs, *State College, Pa.*

BETTER AMERICAN FAMILIES II

The Story of a Family Belonging to the So-Called Middle Class Which in the Course of Generations Has Broken Up into Lines Differing Widely in Social Worth.

Wilhelmine E. Key

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"ALL that we win is a battle—lost in advance—with the irreversible phenomena in the background of nature." So exclaims one school of thinkers over the spectacle of dead and decadent civilizations, while the more hopeful view is voiced in some such phrase as follows: "First and foremost in the perpetuity of national life is the element of belief—an undying faith in human nature." In a previous paper we have already disclaimed any need for such general and impersonal laws of national development, finding the real motive power to lie in the interaction of certain personalities with new combinations of environal characters. These characters, which constituted the resources of the country, together with the new demands on the individual such as adverse climatic conditions, vast distances to be traversed, savage enemies, human and otherwise, have acted to bring to the fore and perpetuate through physical and social selection the trait-complexes best fitted to cope with these conditions. The process of Americanization was found to consist primarily in the establishment of standards by certain regnant personalities, and the more or less perfect approximation to these standards through education on the part of the people.

It is proposed in this paper to examine, more minutely than is usually done, this process of approximation as exemplified in the story of two immigrant families of something more than a century ago. Fortunately the sector of human development known as American history is narrow enough to permit a view in relation to the individuals which determined the dominating quality of its several epochs. We have not yet outgrown the pioneering period of our history; it only assumes new phases from decade to decade, not the least significant of its manifestations being the behavior of "young America" in the war just ended. However, for this study we will take the story of two families through five and six generations from their earliest planting on American soil. We shall try to trace the changes in social worth from generation to generation, both in relation to the economic and social opportunity enjoyed, but also in relation to the type of marriage its various members were able to make. We shall try to express their worth in terms of their leading traits and view their value as social assets as reaction between these traits and the environment. The study comprises nearly two thousand individuals, about one-half of whom are in the direct line of descent from two pairs of pioneers, the remainder being members of the families into which the direct descendants married.

It is estimating character and ability in the individual, chief reliance was placed on the "social test;" and by this was meant sufficient physical and mental soundness to understand the nature and possibilities of his surroundings, to react to them, to conceive social standards and bring his life in conformity to such standards. While the application of standard tests in a study of this sort

is highly desirable, the impossibility of using them on the majority of the persons studied made it inadvisable to use them at all. Moreover, the settled nature of the communities where they lived, with a fair sprinkling of intelligent historians, gave conditions of optimum value for the social test.

In the latter part of the eighteenth century there came to what was then the western edge of the American frontier an immigrant, whom we will designate as Aaron Rufer, with his wife and three small children. He was shrewd, honest, plucky and persevering. He never learned to read or write, but the conditions of his will, which he signed with a cross, show prudence and foresight. He acquired 400 acres of fertile land, which he farmed successfully for thirty years. Aaron's wife, Mary, was totally lacking in sense of number or quantity, for before he went to work in the morning he always measured out the proper amount of meat and vegetables for the family dinner; that done, Mary could tend the fire until a "sort of meal" was in readiness. Moreover, she could neither sew, spin nor weave acceptably, though she was obliging and faithful to the simple tasks she was able to perform.

From Aaron and his defective wife were derived seven children, five of whom were traced to the present generation. They are Isaac, faithful, plodding, with little ability to plan or calculate; Jared, shiftless and dishonest, with little ability to plan or calculate; Stephen, having a fair share of these traits, but non-aggressive, though he persevered in tasks set for him; and Darius, who resembled Isaac. Dorcas and Herman "didn't know anything at all." In his will, Aaron provides ample means and a guardian for them and "the old woman," the guardian to see that these children did not marry. Dorcas never did, but because Herman had been left a good farm, designing persons arranged a marriage with a feeble-minded, sexually lax girl "in order to give her a home." Their four children were very defective, two did not marry, but two married descendants of a couple to be described in the following paragraph.

Thomas and Martha Riel were settled in an adjoining county, where they owned a small farm. Both were very tall and had great physical endurance. Thomas came from a fair family but had certain irresponsible tendencies, which led him to slip away one night, leaving to his wife the care of the farm and their twelve children. The latter, too, were known for their great stature and strength, which in most of them was combined with extreme shyness, good nature and dullness. Two daughters married into stock of varied capacity, and their descendants made alliances with those of Aaron and Mary Rufer. Limited space forbids repetition of the anecdotes from which their characteristics have been derived, but stories like the following could be duplicated many times; Molly Riel, born about 1810, lacking as she was, was still superior to her husband in energy and planfulness, and all that the scanty acres yielded was owing to her. When the census-taker exclaimed at her family of twenty-one children and asked: "Are they all bright?" she nonchalantly replied: "Yes, tol'ably, considering how many the' is of them!" One of her sons, who never married, used to say in explanation: "I like Mam best. Lucky for Pap that he set eyes on Mam before I did; if I'd seen her first, Pap would sure never have got her." A photograph of her sister shows her to have been of large, powerful physique. When her neighbor's child fell into the well, she went down after it, climbing back with its dress held between her teeth, while with her hands and feet she clung to the sides. These two founded strains of widely differing potentiality. In early generations, mental development was very slow; many who were dubbed witless in their teens and twenties later managed their own affairs. And here, marriage into stocks showing a normal rate of development has apparently effected acceleration, so that the mental unfolding comes increasingly

early from generation to generation. Their lines cross those of Aaron and Mary Rufer, to an account of which we now return.

Isaac, the eldest son, married a woman of average ability who lacked sex control and came from a family showing nervous instability manifested largely in alcoholism. Their six children were very diverse, and through their marriages gave rise to branches (A in chart) widely divergent in respect to these traits. Their mentally deficient, immoral daughter, mating with a sexually loose man, had children with lack of sex control in the proportion of two out of three. Later unions with members of families showing higher ability to plan and calculate bring advance in these traits, but persistence of the lack of sex-control. Two members of generation III, who were superior in calculating ability and perseverance but low in aggressiveness, married into strains with an average of the traits, and the subsequent generations are considerably improved, except where a defective daughter, through marriage into a weak strain, carries on the defect in number and perseverance. The remaining members show a good average of social worth, considerably above that of three generations ago.

The wife of Jared, the second son, was able, but sexually lax. Their only daughter seems to have escaped the defects of both father and mother and to have founded a line B showing fair enterprise and morality. Line C was founded by the most able of the brothers, Stephen, and his able, aggressive wife, who came from stock having these traits in good measure. Subsequent marriages into good strains have brought complete elimination of the defects of the founders and corresponding economic worth. Line D, founded by Darius, who closely resembled Isaac, through marriage into sex-offending, alcoholic, criminalistic stock, has broken up into very degenerate branches. There have been a number of marriages here which were arranged as jokes by outsiders, one notably of an epileptic with an imbecile, which fortunately resulted in only one daughter, for twenty years an institutional case, the other children having died. The most degenerate branch arises where lack of number sense and low aggressiveness and perseverance mates with a low degree of these traits combined with sex offense. These defects persist in most of the offspring, but with industry in some cases, and sex control. However, none of the trait-complexes from these defective germ-plasms are such as to produce social fitness; we have, as a result, vagrancy, pauperism, prostitution and petty criminality. With one exception its representatives are all at large, a drain on the resources and a menace to the moral and economic development of their communities. Left to themselves, its degenerate members have gravitated toward degenerate offshoots of other mixed strains, their mating producing an accentuation of the defects of the parents.

The story of line E, founded by the imbecilic Herman, differs from the preceding in that there has been nothing but imbecility from the beginning. After three generations, in which the property has been dissipated, the surviving representatives are happily ending their days in a state institution. This is the line in which marriage has occurred with the defective descendants of Thomas and Martha Riel, the casual nature of which is illustrated by this episode. Walking along a country road a young girl met two boy acquaintances. "Come, let's get married," said she to one. He, however, demurred, whereupon the other one agreed to do so, and they went forthwith and were married. This mating resulted in five children, three of whom died of neglect; the other two were cared for in institutions at an expense of thousands of dollars.

To recapitulate, we have here one of nature's experiments in selective mating, experiments repeated over and over again, and ascertainable if we only give the needed careful study. All members carry defects. "We are none of us

perfect; no, not one." Are these defects relatively few, or so slight as not to seriously impair efficiency, the chance of making good these defects in marriage is correspondingly great. The trait is thus strengthened and remains so unless there is subsequent marriage into strains showing similar weakness or defect. This process has resulted in the practical blotting out of gross defect in three lines (A, B and C) of this net-work. On the other hand, when defect has been marked, or a combination of minor weaknesses has entailed social inadequacy, mating has usually occurred with those equally defective. Where these defects were similar we have a fairly uniform type of unfitness; where dissimilar, the result is a diversity of degenerate condition. This process is illustrated by lines D and E. Marriage was usually with early American stocks, and the sifting out which has thus occurred has brought about an approximation to the standards of the older stocks on the part of the newcomers, so far as their natural endowment permitted. The examination of eugenic conceptions operating in the various matings, the changes in educational and economic opportunity, which came as "accident" or because of the better endowment of the individual, are too long and detailed to be given here. It must suffice to say that the possession of the traits considered, in one way or other, usually operated to secure a greater range and better type of marriage selection. The better ones in consequence are continually pushing out into newer sections of the country, there developing its resources, while the weaker remain behind to mate together, accentuate defects and become a burden on the public. This is graphically shown in the diagram which gives the relation of the various lines to migration.

The story told here has been repeated many times in the history of American settlement. While, no doubt, the wife of Aaron was more defective than the vast majority of pioneer wives, and the level of most families belonging to the Riel group lower than the average, still the relative reaction of its various members to the educational and economic opportunity of their times remains the same. The diverseness in ability simply serves to throw the history of the lines into more vivid relief. There is a well-defined sentiment against marriage into the family in sections where the defective and degenerate members are found. On the other hand, the abler members of the mixed strains feel that stigma and seek to get away where the family is not known. It is related of one of them, that after living in the west for some years, he returned and sought to establish himself at the old home. The effort proving vain, he is said to have exclaimed: "Here I'm only a damned Rufer! I'll go back west where I am as good as anybody!" This he did, and now owns two ranches, is married and a school director, and the father of promising children.

We thus see how heredity, in conjunction with the physical and social selection imposed through the environal factors, operates to bring about concentration of positive characters in the rise of abler lines, who seek to approximate their enterprises and manner of life to the better standards established by the dominating personalities of the period. That the concomitant concentration of defect in other lines does not overwhelm the former process is due to the fact that the survival rate of the defective and degenerate families is below that of the abler families. This at least is true for the families studied here, and is illustrative of "Nature's method" of eliminating the socially unfit and insuring to the "fit" survival and all that survival entails. Where physical and social conditions pertain that encourage a reversal of this process, we have decadence and death.

GOOD QUALITIES ARE CORRELATED

Hope for the Eugenist, and One Objection Answered

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IT is often gratuitously stated that the aims of eugenists will be thwarted because individuals and families possessing rare and desirable qualities are likely, in other important ways, to be decidedly deficient. According to this theory, there is apt to be compensation in the allotment of human gifts. If "some are born fingers, and some are born thumbs," it is assumed that persons over-endowed with thumbs are nevertheless rugged and sturdy and probably staunch in moral fibre. This theory of compensation has been popularized by the emotionally appealing and widely read essay of Ralph Waldo Emerson, which bears the title "Compensation." The philosopher dealt chiefly with the problm of happiness and its dependant spiritual development, and here he may, or may not, be right. However that may be, it is a reasonable assumption that the work of Emerson, as well as that of hosts of other philosophers and preachers, is responsible for the notion that the poor, the sick, the stupid and the generally unfortunate are "the pure in heart," the hallowed possessors of divinely bestowed virtues.

That the exact opposite happens to be the truth, will not interest certain types of emotional and sentimental reformers; but persons desirous of promoting the science of heredity in its application to human problems may be interested in the evidence that accumulates from time to time, *all of which* points in one direction.

There is certainly a slowly growing mass of statistical proof that important mental and moral qualities are correlated. The number of researches is not very extensive, but they should not be overlooked. Most writers on eugenics appear to be unacquainted with the material bearing on this matter and seem thoughtless as to even the existence of such a question. Among authors who have recognized the significance of individual correlations in eugenic discussions may be mentioned E. L. Thorndike and latterly to some extent Popenoe and Johnson in "Applied Eugenics."

Thorndike in his chapter "Eugenics: With Special Reference to Intellect and Character,"[1] accepts the idea of a general correlation of superior and desirable qualities, and quotes Woods[2] as proving the correlation of intellect with morality, and morality with fecundity, in statistics gathered for measurements of royal families, but does not specifically mention subsequent researches, all of which lead to the view that the correlation of superior qualities is probably a general principle of nature.

Thorndike states the matter as follows:

"If we breed horses for speed, they are likely to lose in strength and vigor. Do we run such risks in breeding men for intellect, or for morals, or for skill? This question has been neglected by the hortatory type of enthusiasts for eugenics. It has not received the attention it deserves from the real workers for racial improvement, probably because the psychological investigations which answer it are little known. They do, however, give a clear and important

[1] "Eugenics: Twelve University Lectures." New York, 1914.

[2] *Popular Science Monthly*, Oct. 1903, and "Heredity in Royalty." New York, 1906. Mental and moral correlation was found to be $r = .30$.

answer—that there is practically no chance whatever of injury from selective breeding within a race for intellect, or for morality, or for mental health and balance, or for energy, or for constructive ingenuity and skill — no risk that the improvement of any one of these will cause injury to any of them, or to physical health or happiness."

Among investigations tending to support this theory may be mentioned that of Krueger and Spearman, reported in the *Zeitschrift für Psychologie* in 1906. The tests made by these authors were five in number, and it should be noted that they were of a nature involving very dissimilar mental faculties. The five tests were as follows:

1. Distinction between pitches of given tones.
2. Combination of fragments of printed texts.
3. Establishment of the limits of the sense of touch.
4. Addition of figures.
5. Ease of committing to memory successive series of numbers.

In spite of the wide difference between having an ear especially sensitive to musical tones, and a brain quick at adding figures, the experimentees, who were brilliant in one of these five directions, were found on the average to be brilliant in the other four.

Recent confirmation of this theory is furnishel by W. H. Pyle in the September, 1918, number of the *Journal of Delinquency*. He shows, in his article "The Relation of Mental to Physical Development," that there is good evidence that brighter children are also both anatomically and physiologically superior to children of mediocre mentality and that they are physically superior to their duller schoolmates to an even greater degree.[3]

The same issue of the *Journal of Delinquency* has further evidence bearing on the question of correlations within individuals. Willis W. Clark, who is a field-worker in the Whittier State School for Truants, Whittier, California, finds that one-fourth of the white, one-half of the colored, and one-half of the Mexican Indian boys, committed to the school were definitely feebleminded. Only 17.7 per cent of the total number committed were of average-normal or superior intelligence.

Further proof is to be found in the July number of *Mental Hygiene* (page 445). Here Jessie D. Hodder, Superintendent of the Reformatory for Women, Framingham, Massachusetts, presents statistics which show a slight though measurable correlation between intellectual superiority and freedom from nervous defect. All of the 5,310 cases were women committed to the institution for some form of criminality. The author has classified these individuals into six grades for mentality, (imbecile, moron, subnormal, dull, fair, and good). The method used in classifying is not given, but inasmuch as the material is presented for a purpose other than proving that good qualities are correlated, we may assume that the author has no bias towards such a theory, and we may at least examine the statistics from this standpoint. The percentages of these criminal women who show some form of nervous or mental defect is very high (63.6 per cent) and is itself a manifestation of the joining together of bad qualities. Furthermore, if we sum up the two highest classes in mental grades we find 1,837 persons showing only 39 per cent free from nervous defect, while the three lowest mental classes, 2,390 in number, give an even worse record, or only 34 per cent, free from some one of the four forms of defect here classified under the categories, neuropaths, psychopaths, epileptics and hysterical.

Psychologists have also made tests upon school children and college stu-

[3] See also "Body and Mind," in the JOURNAL OF HEREDITY for June, 1917, Vol. viii, p. 286.

dents. The results are summed up in the following quotation,[4] "He who can learn better than the average through the eyes, tends to learn better than the average through the ears; also he who can attend to one thing better than all other men, will be able to attend to many things at once, or in rapid succession, better than most of them. Artistic ability, as in music, painting, or literary creation, goes with scientific ability and matter-of-fact wisdom. The best abstract thinker will be above the average in concrete thought also. The rapid workers are the most accurate. Intellectual ability and moral worth hang together.

The correlations are, of course, not perfect. A large degree of superiority in one desirable trait may involve only a slight superiority in many others. And since the relations vary enormously amongst individuals, a person highly gifted in one respect will often, though not usually, be very inferior in others."[5]

Thus we see that most of the really important characteristics of human beings—such unquestionably desirable attributes, from the common-sense point of view, as health, intellect and morality (here meaning all virtues in their widest sense) are strongly correlated. Special aptitudes are also correlated. More than this, net fertility is correlated with morality and consequently, to some extent, with intellect also. Furthermore, net fertility has been found to be correlated with longevity, which is itself hereditary to a very great extent.[6]

All these facts warrant us in assigning an immence importance to the whole principle of *correlations within the individual,* and they present a little appreciated though very optimistic outlook for the future of eugenics.

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[4] Thorndike, Edward L.: "Individuality," Riverside Educational Monographs. Boston: Houghton, Mifflin, 1911.

[5] See also B. R. Simpson: "Correlation of Mental Abilities," Teachers' College, Columbia, 1912, p. 122.

[6] Beeton, Miss M., Yule, G. V., and Pearson, K.: "On the Correlation Between Duration of Life and the Number of Offspring," Proc. R. S., London, Vol. LXVII, 1900, pp. 159-171. The material consisted of English and American Quaker families. Also Bell, A. G.: "The Duration of Life and Conditions Associated with Longevity." Washington, 1918. 57 pp.

RESTRICTED ENTRY OF PLANTS TO PROTECT AMERICAN CROPS

No Plants Completely Excluded by New Quarantine—U. S. Department of Agriculture Explains Reasons for Far-Reaching Regulations Which Go into Effect June 1, 1919.

WASHINGTON, D. C.—The effective date (June 1, 1919) of Plant Quarantine No. 37 will mark the operation of new and strict regulations governing the importation into the United States of plants and plant products. The quarantine order has been promulgated by the Secretary of Agriculture to check so far as possible the introduction of more dangerous crop enemies. Experts of the Department of Agriculture estimate that the losses caused by the pests already introduced, for the most part through the agency of imported plants, aggregate half a million dollars annually.

Important provisions of the new quarantine are as follows:

"Requires permits and compliance with regulations for importation of lily bulbs, lily-of-the-valley, narcissus, hyacinths, tulips, and crocus; stocks, cuttings, scions, and buds, of fruits for propagation; rose stocks for propagation, including Manetti, Multiflora, Brier Rose, and Rosa Rugosa; nuts, including palm seeds, for propagation; seeds of fruit, forest, ornamental, and shade trees, seeds of deciduous and evergreen ornamental shrubs, and seeds of hardy perennial plants.

"Leaves unrestricted, except in special cases, importation of fruits, vegetables, cereals, and other plant products imported for medicinal, food or manufacturing purposes; and field, vegetable, and flower seeds.

"Excludes, except as noted in next paragraph, all other classes of plants for propagation, including fruit trees, grapevines, bush fruits, grafted and budded roses, forest, ornamental and deciduous trees, ornamental and deciduous shrubs, pine trees of all kinds, broad-leaved evergreens (such as azaleas and rhododendrons), and a long list of plant material commonly known as florists' stock.

"Excluded plants may still be imported through the agency of the Department of Agriculture, in limited quantities to supply the country with novelties and necessary propagating stock, such entry being safeguarded by the highly-developed inspection and quarantine service which has been organized by the department."

The conditions of entry of these various classes of plants and plant products are given in the regulations under the quarantine. A news letter giving more detailed explanation of the conditions governing importations still permitted, shortly will be sent by the Department of Agriculture to all horticultural, nursery and florist trade journals.

Quarantine No. 37 represents years of careful consideration given to the subject by the experts of the Department of Agriculture, and of the several States, and of the interests concerned, followed by a public hearing, and subsequent further investigation and consultation with the principal nurserymen and florists of this country. The quarantine, therefore, embodies the best judgment of the plant experts of the department, and of the several states, concurred in by most of the interests engaged in actual plant production. It voices the belief that the policy of practical exclusion of all stock not absolutely essential to the horticultural, floricultural and forestry needs of the United States is the only one that will give adequate protection against additional introductions of dangerous plant diseases and insects.—*U. S. Department of Agriculture.*

INBREEDING LIVE STOCK[1]

Dr. G. Pusch.

The author reports experimental work in inbreeding Toggenburg and Erzgebirge native goats, and in inbreeding Friesian milk sheep. In the experimental work with goats Pusch used 18 females and 9 males, making 42 matings and obtaining 77 offspring. With the sheep he used five ewes and one ram, making five matings and producing nine lambs.

The system of breeding followed by Pusch with the goats was the mating of a particular female with her sons for several generations, thus greatly intensifying the blood line and making the animals very closely related.

EFFECTS APPARENTLY DYSGENIC

From two matings of a Toggenburg mother and son two goats were produced that developed very badly and showed chronic dizziness when mature. A mating between daughter and sire produced a kid of low vitality and with chronic dropsy, confirmed by post-mortem examination.

The effect on the numbers of offspring produced was noticeable with this very close inbreeding. The kids became lighter in weight and also more defective in body development. The addition of the blood of another though still closely related line increased the number of offspring produced, but this increase soon disappeared when the close inbreeding was again practiced.

He reports one case in the Erzgebirge gray goats in which a female goat was mated with her son producing Bruno 1. Bruno 1 mated with his dam produced Bruno 2, and Bruno 2 mated with his dam produced Bruno 3. From the first mating with her son she gave birth to four kids. Of the four progeny produced from this mating, one was smothered while young, one was sterile as a male, and the other two were most excellent individuals in every way. The same Erzgebirge was mated four times to a Toggenburg male. Three of the matings produced two kids each, and one mating produced three kids.

Five matings between brothers and sisters in which five females and three males were used showed most unfavorable results. From these matings six kids resulted of which one was sound, one epileptic, two born dead from different mothers, one rickety, and one showed very unsatisfactory development.

In all the close inbreeding only one goat did not become pregnant by her son. She was proven to be fertile by the fact that the next year she bore a kid from another male. Her son was likewise fertile with other females. In several cases there was recognized a distinct inclination to osteomalacia (defective mineral metabolism in the bones) in the offspring from close mating, although care was taken to give the animals proper feed and abundant opportunity to exercise.

INBREEDING GIVES POOR RESULTS

In these experiments brother and sister, sire and daughter, and dam and son matings gave much more unsatisfactory results than cross breeding, line breeding, and moderate inbreeding.

The work with the goats he summarizes as follows: Twelve cross-bred matings gave 26 kids, 25 strong, 1 inferior (3.85%). Nine line bred matings, or moderate inbreeding, produced 18 kids, 15 satisfactory, 3 inferior (16.67%). Twenty-one very close matings produced 33 kids, 15 satisfactory, 18 inferior (54.50%).

Pusch summarizes his results with

[1] Translated from the German by F. A. Hays, Delaware College Experiment Station, Newark, Delaware.

sheep as follows: The first four close matings gave seven lambs of good conformation and development. Cross breeding, on the other hand, gave two lambs which did not develop well.

Summary.—Inbreeding creates homozygous germ plasm, producing animals that breed true, and tends to produce uniformity in the breed. Deliberate and moderate inbreeding has proved itself necessary and useful in live stock improvement, and the reproductive capacity has been favorably influenced thereby.

GENETICALLY SUPERIOR STOCK NECESSARY

Success in inbreeding is only possible where breeding stock has a strong constitution and perfect health. It is not successful in breeds that are too highly refined, and the feeding and shelter must be given careful attention. According to Pusch, if the above conditions are not fulfilled, the offspring from close matings may be over-refined in skeleton, giving small yields of milk, lacking in vitality, and showing low fertility. Existing defects make inbreeding especially dangerous. The certainty of inheritance applies to the defects as well as the strong points of the animals. Inbreeding, therefore, requires continued and careful study of the herd.

Very close inbreeding should be recommended only when special considerations justify and when the breeder is fully conscious of the possible outcome. There is an increasing tendency to discourage such a method in Germany. Moderate inbreeding and line breeding have been used to good advantage in Germany. Carelessness in matings and improper maintenance of the animals have greatly increased the dangers from inbreeding. Inbreeding as a practice can only be carried on profitably where all undesirable traits have been avoided in the breeding stock.

Heredity of Cancer

It is, of course, only in accord with common observation that tumors may develop into sarcomata or other malignant types of growth. The fact that multiple fibroneuromata do so bears on the question of "heredity of cancer," which is so much discussed.

This question is a perennial one. Of late it has come to the fore because of the doubt cast upon heredity of cancer by life insurance actuaries and statisticians using the method of mass statistics. On the other hand, new evidence for the inheritance of cancer has come from the experimental pathologists who all agree that in mice there are strains that cannot grow cancers and others in which they grow rapidly. The hereditary behavior of such strains has even been investigated experimentally by Tyzzer and Little. Now the cancers of mice are so entirely like those of man that it is extremely probable that if the one has an hereditary basis the other has also.

Another reason for the view that cancer is hereditary is that there are races of men who are almost immune to cancers, such as the American Indian, full-blooded negroes and some aborigines of Australia and the Pacific Islands. Also, there are racial peculiarities in the organs affected by cancer; among the Japanase women cancer of the generative organs is about as common as in Great Britain, but cancer of the breast only one-tenth as common. Also, we cannot overlook the significance of such facts as that of the occurrence of sarcoma of the eyeball in three generations in the direct line and four individuals of the middle generation of this family (Silcox, 1892).

Finally, the fact of cancer villages, where there has been much intermarriage, is strong additional evidence of the racial significance of liability to cancer. In view of all these considerations we must consider the presence of an inheritable factor in cancer as practically certain. But we are, neverthelss, very far from a knowledge of the law of its inheritableness. That is a matter for future investigation.—*Eugenics Record Office Bulletin*, No. 19, October, 1918.

RACE MIXTURE IN HAWAII

(Second Series)

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PORTUGUESE AND SPANISH

THE first paper of this series dealt with the Chinese, the Japanese and the Koreans. Portuguese were imported as laborers for the sugar plantations, the principal influx occurring about 1880. They stand second only to the Chinese in length of residence in Hawaii, and now constitute the chief "white" labor. In the case of both Portuguese and Spanish a large percentage (50% or more) of the original immigrants have been dissatisfied with conditions of labor in Hawaii and have emigrated to California. Most of the Portuguese were imported, at the expense of the Government or planters, from Madeira and Fayal. The immigration of foreign-born Portuguese into Hawaii, to 1910, has been as follows:

Previous to 1890	5000
1891–1895	470
1896–1900	215
1901–1905	110
1906	425
1907	1,215
1908	140
1909–1910	780

There has been little immigration since 1910. At present there are about 24,000 Portuguese in Hawaii, 3,400 of whom are laborers on the sugar plantations. In 1917 there were about 6,000 Portuguese children in the schools; they comprise 15% of the total school enrollment and exceed all other nationalities except the Japanese.

The Portuguese have about 3,000 registered voters in Hawaii and comprise politically the best element in Hawaii's diverse immigrant population.

The marriages during a typical five-year period (see previous paper for data) have been as follows:

FULL-BLOODED PORTUGUESE

Nationality of mate	*Men*	*Women*
Total marriages	1,139	1,463
Portuguese	991	991
American-Portuguese	0	1
British-Portuguese	1	12
German-Portuguese	2	0
Swedish-Portuguese	1	0
Norwegian-Portuguese	1	0
Spanish-Portuguese	1	1
Mexican-Portuguese	1	1
Italian-Portuguese	0	5
Chinese-Portuguese	4	2
Japanese-Portuguese	1	0
Spanish	20	20
Italian	0	1
Greek	1	0
French	6	0
Galician	1	2
Mexican	1	0
American	6	194
British	3	15
Norwegian	1	4
Swede	0	4
Dutch	0	1
Dane	0	2
German	4	16
German-Spanish	1	0
Austrian	1	1
Russian	3	4
Chinese	0	11
Japanese	0	8
Korean	0	9
Filipino	2	58
Porto Rican	3	24
Hawaiian	40	31
Caucasian-Hawaiian	34	24
Chinese-Hawaiian	13	8
Japanese-Hawaiian	1	0
South Sea Islander	0	1
Other nationalities	1	6

SUMMARY

1. The majority of Portuguese men marry Portuguese. Their national preferences, outside their own group, in quantitative sequence are: Hawaiian, Caucasian-Hawaiian, Spanish, Chinese-Hawaiian.

2. No Portuguese men married full-blooded Oriental women (Chinese, Japanese, Koreans). Only 2 married Filipinos, whereas 58 Portuguese women married Filipinos; 19 Portuguese men married part-Oriental women.

3. Of the total marriages, both men and women, 174 were with mates of Polynesian or mixed Polynesian stock; 259 were with mates of American or North European stock; 67 were with mates of South European stock (aside from Portuguese).

4. Among the other significant figures, from the standpoint of race-mingling, are these: 194 Portuguese women were married by Americans, 58 by Filipinos, 28 by Orientals, 24 by Porto Ricans, 63 by Hawaiians or part-Hawaiians.

5. An appreciable percentage of Hawaii's population is more or less infused with Portuguese blood, as witnessed by the marriages of full-blooded Portuguese men and women with mates of mixed Portuguese blood.

PART PORTUGUESE

- 1 Portuguese-Spanish woman married a Mexican.
- 1 French-Portuguese woman married an American.
- 1 German-Portuguese man married a Caucasian-Hawaiian.
- 4 German-Portuguese women married Americans.
- 3 German-Portuguese women married Germans.
- 2 German-Portuguese women married Caucasian-Hawaiians.
- 1 Norwegian-Portuguese woman married a German.
- 1 Danish-Portuguese woman married a Caucasian-Hawaiian.
- 2 British-Portuguese women married Americans.
- 1 British-Portuguese woman married a Swede.
- 2 Chinese-Portuguese women married Norwegian-Portuguese.
- 1 Chinese-Portuguese woman married a Spaniard.
- 1 Chinese-Portuguese woman married an Italian-Portuguese.
- 1 Chinese-Portuguese woman married a Caucasian-Hawaiian.
- 1 Japanese-Portuguese man married a Japanese-Portuguese.
- 1 Japanese-Portuguese woman married a Korean.

These tables testify to a remarkable breaking-down of "race barriers" in Hawaii. The intermarrying of the Portuguese with other peoples in Hawaii is only exceeded by the Hawaiians and the Americans. It is unfortunate that we do not possess detailed accurate eugenic data concerning the progeny of these unions.

THE SPANISH

The Spanish in Hawaii are very much like the Portuguese in character, intellect, economic and social status. There are only about 3,000 Spanish, many of the original immigrants having "gone to the coast." Practically all were imported originally to furnish cheap field labor for the sugar plantations. The Spanish school population has decreased in recent years; it comprises less than 2% of the total school enrollment.

MARRIAGES, FULL-BLOODED SPANISH
(5-YEAR PERIOD)

Nationality of mate	*Men*	*Women*
Total marriages	207	269
Spanish	177	177
Portuguese	18	20
Porto Rican	5	11
Filipino	0	25
Hawaiian	2	0
Caucasian-Hawaiian	1	3
Chinese	0	1
Chinese-Portuguese	0	1
Japanese	1	0
Korean	0	10
American	0	10
British	0	4
French	0	1
Greek	0	1
Norwegian	0	1
German	0	1
Russian	2	
Other nationalities	1	

- 1 Portuguese-Spanish woman married a Portuguese.
- 1 Portuguese-Spanish woman married a Norwegian.
- 1 British-Spanish man married a Caucasian-Hawaiian.
- 1 British-Spanish woman married a Briton.
- 1 German-Spanish man married a Portuguese.
- 1 Indian-Spanish woman married an American.

SUMMARY

1. Most Spanish men married Spanish women. Spanish women marry freely outside their nationality.

2. A small amount of intermarrying takes place between Spanish and Portuguese.

3. A notable number of Spanish women are married by Porto Ricans and Filipinos.

4. The intermarrying between Spanish and Hawaiian and part-Hawaiians is very slight, especially when contrasted with the Portuguese in this regard.

5. Practically no Spanish men marry Oriental women; ten Spanish women were married by Koreans.

6. Practically no Spanish men marry Americans or Europeans (except Portuguese). Spanish women have been married by Americans and Europeans.

THE NATIVE HAWAIIANS

The primitive Hawaiians were Polynesians, and part of the splendid Maori-Samoan-Hawaiian brotherhood. This group comprised one of the finest physical types known in the history of the human race. For a detailed account of the primitive Hawaiian physique, see the author's "Physique of the Ancient Hawaiians" in the *Scientific Monthly*, 5: 166-74, August, 1917.

The present paper cannot deal with the successive tragic stages in the extinction of the ancient Hawaiian, nor can it analyze the complex and inexorable factors that so rapidly consumed this noble race. In 1778 there were probably no less than 300,000 native Hawaiians, the sole inhabitants of "the loveliest fleet of islands that lies anchored in any ocean." Five decades later, in 1823, the census showed only 142,000. At the close of another decade the native population had dropped to 130,000. The next interval of thirty-six years witnessed a frightful decrease of two-thirds of the total population, reducing the natives to 44,000. In 1900 there were but 30,000; the past eighteen years have probably cut this nearly in half. The official figures of the Board of Health give 26,000 native Hawaiians for 1910 and about 23,000 for 1917, a decrease of 3,000 in seven years. All of the above figures are for full-blooded Hawaiians. The part-Hawaiian population is given as 12,500 for 1910 and 16,000 for 1917, a marked increase, which is growing steadily from year to year. It should be noted that a very considerable percentage of the persons listed as "native Hawaiians," especially in later years, are not full-blooded Polynesians. The natives have married, with startling promiscuity, both in and out of wedlock, with all the motley hordes who have come to their shores. Today it is practically impossible to determine pure lines of descent. There are probably not 10,000 pure-blooded Hawaiians living today.

The first two gifts of the white man to the Hawaiian were alcohol and venereal disease, and these have been powerful agents in the demoralization of the race. Other introduced bacterial diseases—plague, measles, leprosy, tuberculosis, pneumonia, etc.—have horribly ravaged these susceptible people. Foreign clothing, unsanitary housing, immorality grossly encouraged by a certain portion of the white population, and an economic system to which the Polynesian was absolutely unadapted—these factors have all contributed to wipe out a human type that had many physical, mental and spiritual attributes of lovely and superior quality.

The marriages of the Hawaiians and part-Hawaiians, during a typical five-year period (see previous paper for data) are tabulated on (Table I) opposite page. The period, 1913-1917, is the same throughout the papers in this series, so that the data are comparable.

SUMMARY

1. Most Hawaiian men marry Hawaiians. Hawaiian women marry freely outside their own race.

2. Notable among the racial preferences of Hawaiian men are their marriages with Caucasian-Hawaiians, Chinese-Hawaiians, and Portuguese.

3. Hawaiian women were selected by the following nationalities, in order: Hawaiian, Caucasian-Hawaiian, Chinese, Chinese-Hawaiian, American, Filipino, Korean, Portuguese, Japanese.

4. Of special note is the large amount of intermarrying between the various

Table I

Nationality of mate	Hawaiian		Chinese-Haw'n		Caucas-Haw'n.	
	Men	Women	Men	Women	Men	Women
Total marriages	1,256	1,694	173	240	444	625
Hawaiian	1,007	1,007	82	72	144	124
Chinese-Hawaiian	72	82	27	27	36	47
Japanese-Hawaiian	0	3	0	1	1	3
Korean-Hawaiian	0	0	0	1	0	0
Filipino-Hawaiian	0	0	0	0	1	1
Caucasian-Hawaiian	124	144	47	36	197	197
African-Hawaiian	1	0	0	0	0	0
Hawaiian-Alaskan	0	2	0	0	0	0
South Sea Islander	2	1	0	0	0	0
Chinese	4	140	7	59	1	27
Chinese-Portuguese	1	0	0	0	1	1
Japanese	2	27	0	1	2	4
Korean	0	52	0	5	0	2
Filipino	1	65	0	4	1	4
Spanish	0	4	0	0	3	1
Portuguese	30	40	8	15	24	34
Porto Rican	0	3	0	0	1	0
American	6	78	1	15	19	136
British	0	17	0	1	4	18
British-Spanish	0	0	0	0	0	1
French	0	0	0	0	1	2
Italian	0	0	0	0	1	0
Swiss	0	1	0	0	0	0
German	0	16	0	2	3	19
German-Portuguese	0	0	0	0	2	1
Austrian	0	1	0	0	0	0
Belgian	0	0	0	0	0	1
Dane	0	1	0	0	0	0
Norwegian	1	4	0	0	1	2
Swede	0	4	0	1	0	4
Russian	1	0	1	0	1	0
Other nationalities	3	0	0	0	0	2

European stocks and the Hawaiian and part-Hawaiian, giving rise to an unique European-Polynesian-Asiatic blend.

5. Two hundred and fifty-five Americans married Hawaiian or part-Hawaiian mates; of these 26 were American women.

6. In view of the fact that Japanese comprise over 50% (over 100,000) of the total population of Hawaii, the almost negligible degree of intermarrying with the Hawaiian stock is extraordinary. Only 4 Hawaiian or part-Hawaiian men married Japanese women, and only 32 Japanese men married Hawaiians or part-Hawaiians.[1]

[1] A valuable sociologic and eugenic analysis of the Hawaiian-Caucasian-Chinese blend has been made by Ernest J. Deece (*Amer. Jour. Sociology*, 20: 104–116, July, 1914). The reader is referred to this very interesting and suggestive paper, with the conclusions of which the present writer fully agrees.

Those readers who are interested in the decline of the Hawaiian people are referred to W. F. Blackman's "The Making of Hawaii," for much instructive sociological data.

AMERICANS, BRITISH, GERMANS

The "white" population of Hawaii numbers about 25,000, classed as follows:

Army and Navy	7,000
Americans, civilians	16,000
British	1,000
Germans	1,000

During the period following the discovery of Hawaii by Captain Cook (1778), British influence became pronounced, and many English and Scotch came to Hawaii. At the present time many of the old plantation managers are Scotchmen, and before the war there was a slender but constant migration from Scotland to Hawaii. In Vancouver's time the Hawaiian chiefs ceded the islands to Great Britain, but this action was not ratified by Parliament.

The political destinies of Hawaii were sealed by the arrival of the American missionaries in 1820, and the development of the North Pacific whaling industry in later years. For over a century Americans have shaped and controlled the life of Hawaii. During the middle of the nineteenth century, when Prussia began her futile dream of world-empire, German trading stations were established in Hawaii. With the rapid growth of the sugar industry these posts became powerful commercial agencies of strategic Pan-Germanistic value. This fact was demonstrated during the recent war, during which the German-"American" community of Hawaii was a veritable hotbed of espionage, disloyalty, treason, and criminal acts. Virulent disease germs were secretly disseminated under direction of the German consulate, and were only controlled by the prompt and drastic action of the territorial authorities.

The preceding brief sketch will indicate the origin and character of the American, British, and German groups in Hawaii. Most of the industrial, financial, mercantile, and professional leadership in Hawaii resides in the American-British group. A considerable percentage of the German colony is of low-grade peasant origin and ranks with the Spanish and Portuguese. Table II (page 95), showing marriages during the five-year period 1913-1917, is similar to those of previous papers in this series and the data are comparable.

SUMMARY

1. Only one-half of the American men married Americans; most of the American women married Americans. In numerical order, American men married Americans, Portuguese, Caucasian-Hawaiians, Hawaiians, British, German, Chinese-Hawaiians, and Porto Ricans.

2. Only 13 American men and 3 American women married Asiatics; 15 American men married Chinese-Hawaiians; 223 married women of Hawaiian or part-Hawaiian blood.

3. The 116 American women who did not marry American men married, in order: British, Caucasian-Hawaiians, Germans, Hawaiians, Portuguese.

4. British men married, in order: Americans, British, Caucasian-Hawaiians, Hawaiians, Portuguese, German, Norwegian. British women married, in order: British, Americans, Caucasian-Hawaiians, German, Portuguese.

5. Most Germans married others than Germans; in order: American, Caucasian-Hawaiians, Portuguese, Hawaiians, British.

6. These tables show the definite blends that are occurring between American-British-German stocks and such stocks as the Hawaiians, part-Hawaiians, and Portuguese. The direct blending with Asiatic stocks is almost negligible, although considerable intermixture is taking place via the Chinese-Hawaiians.

From the eugenic standpoint there can be no doubt that many, if not most, of the intermarriages of the American and North European stocks with dark-skinned peoples are *biologically wasteful*. The Englishman, for example, who marries a Hawaiian, a Hindu, or a Chinese, may have offspring of superior quality, but most of the Caucasian-Hawaiians seem to blend the least desirable traits of both parents. The English-

TABLE II

Nationality of mate	American		British		German	
	Men	Women	Men	Women	Men	Women
Total marriages	1,089	640	206	126	109	71
American	524	524	63	49	9	19
American-Portuguese	0	0	1	0	0	0
British	49	63	58	58	4	9
British-Portuguese	2	0	0	0	0	0
British-Spanish	0	0	1	0	0	0
French	10	0	4	1	1	0
French-Portuguese	1	0	0	0	0	0
Galician	2	0	1	0	0	1
Greek	0	0	1	1	1	0
Italian	0	0	1	0	0	0
German	16	8	9	3	2	25
German-Portuguese	4	0	0	0	3	0
German-Japanese	1	0	0	0	0	0
Austrian	3	1	0	1	5	2
Dane	3	0	0	1	0	0
Dane-Portuguese	0	0	1	0	0	0
Norwegian	8	4	5	1	2	2
Norwegian-Portuguese	0	0	0	0	1	0
Swede	2	2	1	1	0	0
Russian	2	0	0	1	2	1
Hawaiian	78	6	17	0	17	0
Caucasian-Hawaiian	130	19	18	4	19	3
Chinese Hawaiian	15	1	1	0	2	0
Portuguese	194	6	15	3	17	3
Mexican-Portuguese	1	0	0	0	0	0
Spanish	10	0	4	0	1	0
Indian-Spanish	1	0	0	0	0	0
Porto-Rican	15	0	0	0	1	0
Chinese	6	1	1	0	0	0
Chinese-American	1	0	0	0	0	0
Japanese	2	1	1	0	0	0
Korean	0	0	0	0	1	0
Filipino	4	1	2	0	1	2
Other nationalities	1	3	0	1	1	3

man who marries an Englishwoman is more likely (all other factors being equal) to perpetuate the most desirable traits and traditions of his people. The large "half-white" population that has sprung up wherever the white man has gone among dark-skinned peoples testifies to the enormous squandering of the hereditary physical, psychic, and racial traits of the North European.

The author's mature conclusion, after a decade of intensive observation in Hawaii's microcosmic melting-pot, is that biological race mingling is desirable only when it is identified with *normal Christian home life,* and only when the contracting parties are *superior specimens* of their respective racial types. Most biologic race-mingling, throughout all history, has occurred under conditions which have heavily discounted the eugenic value of such mingling.

The
Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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FOREST OF OLD DATE PALMS IN THE SAHARA

The photograph illustrates what was perhaps the first home of the breeders of plants, from four to six thousand years before our era. (From Bull. 53, Bur. of Plant Industry, U. S. Dept. of Agriculture.) (Frontispiece.)

THE FOUNDERS OF THE ART OF BREEDING

Herbert F. Roberts
Kansas State Agricultural College

FIRST HOME OF BREEDERS OF PLANTS

EXACTLY where or when men first began to practice agriculture, and to bring into cultivation and domestication the plants and animals they found about them, no one can tell. It is certain, however, that one of the earliest homes of civilized man upon earth was in the lower basin of the Tigris and Euphrates rivers in southwestern Asia, the site of the biblical "Garden of Eden," known locally today by the Arabic name of "Iraq."

From four to six thousand years before our era, and at least fifteen hundred years before the days of the Jewish patriarch Abraham, this region was occupied by an already ancient, orderly and settled civilization, possessing cultivated plants and domestic animals. Indeed, there is little reason to doubt that the low alluvial plain fed by the "waters of Babylon" was the scene of one of the very first of man's attempts at the improvement of plants, for it is known that, at the earliest time recorded in human history, the cultivation of the date palm was being carried on in this region.

DATE CULTURE IN ANCIENT BABYLONIA AND ASSYRIA

The history of the date palm typifies, better than that of almost any other plant, man's relation to the plant world as a moulder of its cultivated forms. The great extent of the culture of dates in Mesopotamia in ancient times, is made very plain to us from the many Babylonian and Assyrian inscriptions. The monuments of these ancient empires show not only the methods of culture and the serving of the date as food, but even the process of hand pollination (10).

From the ruins of Nineveh there comes, for example, an inscribed monument of Ashurbanipal, who lived about 650 B. C., king of Assyria at the zenith of its power, the Sardanapalus of the Greeks, and the "Grand Monarque" of the ancient world.

In this bas-relief he is represented upon a couch in his garden. Over his head stretch the loaded garlands of the grape vine, while to the rear stands a date palm laden with fruit.

The tremendous economic value of this remarkable tree, even in those early times, is attested by a Babylonian hymn, quoted by both Pliny and Strabo, which recites three hundred and sixty uses for the plant. As late as the thirteenth century, the celebrated traveler, Marco Polo, speaks of "a great city called Bastra (modern Busreh) surrounded by woods, in which grow the best dates in the world."

WHY MEN LEARNED PLANT BREEDING FROM THE DATE PALM

It had probably always been recognized, since animals were first extensively domesticated, that the fact of sex lay at the basis of whatever improvement in their characters man could bring about, for the reason that, in animals, "breeding" has always meant the use of superior animals (usually superior males) in crossing. In plants, however, the existence of sex is less evident than in the case of animals, partly because of the fact that in most plants the sexes are not separated. But in the date palm, we have at once a plant of supreme economic value in certain regions, and one in which the sexes exist separately as in all the higher animals. Indeed it came to be recognized, from the earliest times, that date trees were of two kinds, sterile and

THE BREEDING OF DATE PALMS

Cluster of female flowers being tied together to hold the sprig of male flowers in place. It has been recognized from earliest times that date trees were of two kinds, sterile and fruit-bearing, and that the product of the sterile trees was needed to insure the bearing of fruit. (From Bull. 53, Bur. of Plant Industry. Loaned by the U. S. Dept. of Agriculture.) (Fig. 1.)

fruit-bearing, and that the product of the sterile (male) trees was needed in order to insure the bearing of fruit by the other (female) trees.

Kazwini (5), the Arabic writer on natural history, says of the date, "It is created out of the same substances as Adam, and is the only tree that is artificially fertilized." The seeds of the date produce about half and half, male and female trees. The female trees are wind pollinated, and there would, therefore, easily be enough male trees to fertilize them under natural wild conditions. However, under cultivation, the growing of such a large proportion of non-fruit-bearing or male trees, would be a very wasteful use of the land, and we find that as early as Babylonian and Assyrian times it was discovered that the pollen from a small number of male trees could be made to suffice for fertilizing a considerable number of female trees, by substituting hand pollination for the natural method. At the present time, according to Swingle (10) the proportion used in planting is about one male to one hundred female trees.

VARIATION AND SELECTION OF DATE PALM

It was soon learned that, when the seeds from the fruits thus obtained by fertilization were planted, the offspring could no more be depended upon to bear fruits like those of the mother tree than can the seedlings of our modern "budded" peaches, apples, or pears. As a matter of fact, the seedlings coming from any given variety of date show a very wide range of variation, and it is said that the original parent type seldom reappears among the seedlings (10).

This diversity of type among seedling dates has led to the establishment of a great number of varieties in cultivation. From four cases of the Sahara alone, over four hundred distinct varieties of date palms are reported, which vary greatly in the size, shape and flavor of the fruits, some being round, some oval, others slender and elongated. In color the fruits vary from light brown to deep black. Some varieties ripen dry, and furnish a staple food product useful for long journeys. Others are so soft and syrupy that they must be eaten fresh.

Thus we see that, through the medium of the date palm, man, in one of his earliest homes, learned two great facts upon which all plant improvement rests—the fact of variation, which makes selection possible, and the fact of plant sex, upon which "plant breeding" in the true sense is based.

DISCOVERY OF SEX IN PLANTS THE LESSON THAT WAS LOST

We have seen that the Babylonians understand that the date palms were of two sorts, male and female by nature, and that they utilized this knowledge in a practical way by resorting to artificial pollination of the female trees in order to make them bear more abundantly. We also know that the Arabs have continued this practice uninterruptedly to the present time. Indeed they seem to have had a distinct understanding that the date palm possessed sex in the same sense in which it exists in the animal kingdom. Kazwini, who died about 682 A. D., and to whom reference has already been made, says plainly in his book: "Of the marvels of Nature, and of the Singularities of Creating Things," the date has a striking resemblance to man, through the beauty of its erect and slender figure, its division into two distinct sexes, and the property, which is peculiar to it, of being fecundated by a sort of union."

However, the lesson which the date palm might have taught men—that all plants possess sex, and hence that breeding can be conducted with them as with animals—appears to have been lost. Even in those regions where the date was grown, the idea which the long-continued practice of artificial pollination ought to have suggested—that it was possible to breed and improve other plants in like manner—seems never to have arisen. One would naturally suppose that the ancient Babylonians, having learned the art of artificial crossing in the case of one plant, would have applied the same process to others.

THE POLLINATION OF THE DATE PALM

In the date palm the sexes exist separately as in all the higher animals. Arabs inserting a sprig of male flowers. (From Bull. 53, Bur. of Plant Industry, U. S. Dept. of Agriculture.) (Fig. 2.)

R. J. CAMERARIUS

In 1694, Camerarius wrote an extraordinary "letter" to his friend Professor Valentin. This letter fills some fifty printed pages, is entitled "*De Sexu Plantarum Epistola*." (Fig. 3.)

The reason for their failure to do so is, however, in a measure explainable. No other important plants with which they came into contact in their fields exhibited a similar striking division into two distinct sexes. For example, they did not chance to possess at the same time a plant like Indian corn, in which the sexes are at least partially separated, in which pollination is a conspicuous fact, and in which crossing not only can be seen to be continually taking place in nature but can likewise easily be carried out by artificial methods. Otherwise it is possible that a further advance would have been made in plant breeding, even in those early times. As a matter of fact, no second lesson was learned. The book was closed, and the land of Babylonia, where the first plant breeders lived, became the desert which it remains to this day. Literally, in the words of the Prophet Jeremiah, "Her cities are a desolation, a dry land and a wilderness."

BEGINNING OF THE NEW LESSON

Ages of oblivion had rolled over the land where nature taught men their first lesson in plant breeding. Nearly all that we commonly call the history of the world had taken place. On the 25th of August, 1694, in his laboratory in the University Tübingen, in South Germany, Rudolph Jacob Camerer, Professor of Natural Philosophy, better known to science under his latinized name of Camerarius, finished the writing of an extremely long letter to his friend, Professor Michael Bernhard Valentin, of the University of Giessen. This extraordinary "letter," which fills some fifty printed pages, is entitled *"De Sexu Plantarum Epistola."*[1] It recounts at length, not only the knowledge, slender enough though it was on this subject, which existed up to his time, but gives a full description of Camerarius' now extensive experimental work.

It is almost incredible, but it is a fact, that this constitutes the first piece of acual scientific investigation into the quesion of the existence of sex in plants that had ever been made, since the date palm had thrown out its first plain and single suggestion more than seven thousand years before.

The Greek and Roman writers on natural history, Aristotle (1), Pliny (8), and Theophrastus (11), had commented on the supposed nature of sex in plants; Theophrastus, and especially Pliny, even citing plainly and definitely the case of the date palm; but it is evident, from the vague and contradictory nature of their views, that they carried on no experiments to determine the facts. This was exactly, however, what Camerarius did.

He was the first botanist to discover by actual experiment that the pollen is indispensable to the fertilization of the seeds, and that the pollen-producing flowers or plants are therefore male, and the seed-bearing ones female, in nature. Camerarius conducted his experiments with spinach, hemp, and hops, in which the pollen and seed-bearing plants are distinct, and with Indian corn, or maize. He was likewise the first botanist to discover, two hundred years after maize had been introduced into Europe from America, what seems to us a simple and every-day fact, that on removing the pollen-bearing flowers from the tassel of an isolated corn plant the seeds on the ears remained unfertilized.

PREPARING WAY FOR BREEDERS

The outcome of his experiments, together with the results obtained with the other plants mentioned, enabled Camerarius (2) to come to this conclusion regarding sex in plants (p. 28):

"They behave indeed to each other as male and female, and are otherwise not different from one another. They are thus distinguished with respect to sex, and this is not to be understood, as is ordinarily done, as a sort of comparison, analogy, or figure of speech, but is to be taken actually and literally as such."

We have thus reached another definite landmark in plant breeding. First, the date palm suggested the idea that

[1] Letter concerning the sex of plants.

IOANN. GEORG. GMELIN
MED. D.

SERMO ACADEMICVS
DE

NOVORVM VEGETABILIVM

POST CREATIONEM DIVINAM

EXORTV

D. XXII. AVG. cIↄIↄccxlix.
PVBLICE RECITATVS

ADDVNTVR

PROGRAMMA AD PANEGYRIN
HANC INVITANS

ET PROPTER MATERIÆ NEXVM

D. RVD. IAC. CAMERARII
PROF. OLIM TVBING. LONGE CELEB.
AD D. MICH. BERN. VALENTINI
PROF. GIESS.

DE

SEXV PLANTARVM

EPISTOLA.

TVBINGÆ LITERIS ERHARDTIANIS.

CAMERARIUS' TITLE PAGE

Introductory page to Camerarius' published letter upon sex in plants, written in 1694. (Fig. 4.)

plants possess sex as do animals, but not a single experiment is recorded until Camerarius, attacking the problem in the modern way, by means of an experimental garden and a microscope, found that sex actually exists in plants as it exists in animals. The knowledge of this fact opened the way for the work of experimental plant breeding. As we have seen, "plant breeding," strictly so-called, means the production of new types of plants as the result of crossing. Therefore, the science of breeding involves a knowledge of, first, the fact of sex, and second, of the behavior of hybrids. Thus the barrier to progress in plant breeding was removed by Camerarius' discovery of sex in plants.

Nor did his searching mind fail to sense the great possibilities latent in the field of hybridization which were involved in this discovery, for he says in passing (p. 49):

"The difficult question, which is also a new one, is whether a female plant can be fertilized by a male of another kind, the female hemp by the male hops; the castor bean from which one has removed the staminate flowers, through pollination with the pollen of Turkish wheat (maize); and whether, and in what degree altered, a seedling will arise therefrom."

In this striking sentence we find outlined, although in fantastic guise, the germinal conception which underlies all plant breeding, viz., the creation, through crossing, of new and hitherto unknown types. In this brief paragraph we glimpse the fresh spirit of a new era of scientific investigation.

Camerarius, however, seems never himself to have attempted the artificial crossing of plants, and it was a full hundred years before his discovery regarding sex in plants received any recognition whatsoever, and before we find the first recorded instance of an actual experiment in hybridization.

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BETTER AMERICAN FAMILIES III

Showing How the Level of a Trait or Trait-Complex May Be Raised Through Marriage-Selection

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IN tracing the history of the Rufer family as given in the preceding paper, the conclusion seems justified that through selective matings, the grade of such traits as aggressiveness, perseverance and the ability to handle number was noticeably increased or diminished. For example, in Line E the absence of such abilities with the concomitant failure of the individuals to marry those possessing the abilities in question persisted through five generations. In Line C a comparatively low ability to calculate has, through selective matings with good or average ability, been built up into ability which is average or in some instances even above the average. This holds true also of the trait-complex aggressiveness. In Line D again, ability with number, and aggressiveness have through matings with a low grade of these abilities, persisted at the low level of the original founders. In the same way the trait-complex perseverance is found to move up or down in fair accord with the type of mating made.

Let us now see how far the behavior of these abilities in inheritance conforms to the Mendelian hypothesis. At the outset, we concede that our data, since they appertain to mental and temperamental traits, do not permit of the accuracy of measurement possible in handling physical traits. It will, however, be generally agreed that all have a basis in heredity and remain far less affected by environmental influences than many other characters that might be selected for study. And with at least one ability, that of dealing with number, it is possible to adhere to uniform objective standards. Our justification for attempting to carry the Mendelian principles into this domain is the value which even approximate conclusions may have for future effort along similar lines.

THE ABILITY TO CALCULATE

If we let C stand for comparative presence of determiners for this ability, and c for their comparative absence, whether they occur in a unit-like series of similar or various elements, we have the following possible combinations in the union of germ plasms: CC developing relatively high ability which we may indicate by H; Cc developing mediocre ability indicated by M; and cc developing low ability indicated by L.

Distribution of these abilities from different types of mating would be as follows:

cc x cc —100% cc., *i. e.*, All children show very low ability.
Cc x cc —50% Cc and 50% cc. Half the children show medium ability, half low ability.
Cc x Cc —25% CC, 50% Cc and 25% cc. One-fourth the children with high, half with medium and one-fourth with low ability.
cc x CC—100% Cc. All children show medium ability.
Cc x CC—50% Cc and 50% CC. Half show medium ability and half high.
CC x CC—100% CC. All children show high ability.

In the studies of distribution as actually occurring in the Rufer family, the germinal constitution was necessarily inferred from the character of the individual. That is, low ability was taken to indicate the germinal constitution cc, or all germ cells with relative absence of determiners for calculating ability. Cc medium ability, with half the germ cells having determiners and half not having sufficient determiners for this ability; while high ability indicates the germinal constitution CC, or all germ cells with sufficient determiners for this ability.

Let us examine first the distribution of the grades of this ability in a group of the Rufer family where the level of the ability is distinctly lower than that of the general population. Here class 1, indicated by L, includes all those having no ability to handle quantities beyond 5; class 2, indicated by M, includes all those able to perform simple multiplication and division, and make small change; class 3, indicated by H, includes all those having ability beyond this, but still not above the average for the general population. The progeny of 48 matings, including 177 offspring were graded and their distribution in the three classes compared with the theoretical expectation as given above.

Comparison of percentages realized with percentages expected:

	L	x	L	L	x	M	L	x	
	L	M	H	L	M	H	L	M	H
Expected..	100			50	50			100	H
Realized...	100			52^{9}	33^{3}	13^{8}	30	60	10

	M	x	M	M	x	H	H	x	H
	L	M	H	L	M	H	L	M	H
Expected..	25	50	25		50	50			100
Realized ..	18^{5}	70^{4}	11^{1}	13^{1}	39^{1}	47^{8}		2^{4}	97^{6}

The realized percentages support the following conclusions: (1) When both parents show a low grade of this ability, all the children are similarly of low grade. (2) When both parents show high ability, practically all the children are similarly endowed. (3) When one parent shows a low grade and the other a medium or high grade the increase in the percentage of medium and high is proportionate to the grade of the abler parent. Although a small proportion of low grades are produced by the mating of a medium with a medium of high grade, here again the proportion of low grades shows greater decrease when one consort is of high grade than when he is of medium grade.

A similar study of the distribution of grades of calculating ability was made in the Riel group. The distribution of thirty-two families including 120 individuals was determined, only here, different values were assigned to the three classes. L included all those who could perform simple multiplications and divisions and make small change; M included all those with average ability, while H included all those with ability above the average. The comparison of percentages realized with percentages expected follows:

	L	x	L	L	x	M	L	x	H
	L	M	H	L	M	H	L	M	H
Expected..	100			50	50			100	
Realized...	86^{6}	13^{4}		47^{6}	52^{4}			70	30

	M	x	M	M	x	H	H	x	H
	L	M	H	L	M	H	L	M	H
Expected..	25	50	25		50	50			100
Realized ..	38^{6}	42^{8}	28^{6}	5^{7}	38^{8}	55^{5}			

The realized percentages in this group support all the conclusions drawn from study of the Rufer group, with the exception of the second conclusion, the mating of high ability with high not having occurred.

If we adopt the hypothesis of a unit-like series of determiners in the germ plasm to account for the development of this ability, we may conceive the number which means presence in a low degree in the poor strains, to be replaced by a larger number of determiners and consequent good ability in the better strains. Should this replacement, through "good matings" occur for a number of generations, a point may be reached where fair and good ability would still appear in the offspring, even though there be mating with low ability. That is, relative absence in the germ plasm of the better consort would behave as relative presence to the lack in the weaker consort; the resulting simplex individual would show and transmit fair ability. The serious danger would arise from matings in two consecutive generations with low or no ability. In such cases there would be

reversal of the process and the production of an increasing proportion of children with low ability. We would appear to have here then, segregation, a real alternative inheritance, with possibly units of progressively higher potency as we pass from strains having a low level of this ability to those with superior endowment.

AGGRESSIVENESS

This trait-complex may be defined as energy and courage in the undertaking of new projects. It will be seen at once that the grades of this character cannot be fixed with the definiteness possible when dealing with number. They were evaluated with reference to the economic and social opportunity, physical and mental limitations and the effect of example on suggestible individuals. The distribution of 282 individuals, the product of eighty matings was as follows:

	L	x	L	L	x	M	L	x	H
	L	M	H	L	M	H	L	M	H
Expected..	100			50	50			100	
Realized...	88^8	11^2		51^6	46	2^4	30^3	60^6	9^1

	M	x	M	M	x	H	H	x	H
	L	M	H	L	M	H	L	M	H
Expected..	25	50	25		50	50			100
Realized..	17^6	75^9	6^5	3^2	47^4	49^4		25	75

Here again the realized percentages would indicate the heritability of this trait-complex in accordance with the theory of segregation of determiners for the trait-complex. The slightly wider discrepancy between the expected and the realized results is no doubt due to the difficulty of evaluating the character. It will be observed that the discrepancy is considerable only where both parents are moderately aggressive, or where one has a very low grade while the other has a high grade of the trait. In both cases, the offspring show greater resemblance to the parents than the hypothesis would lead us to expect.

PERSEVERANCE

In dealing with this trait-complex, we are again confronted by the difficulties involved in its evaluation. As in the case of aggressiveness, the social inheritance plays a far greater role in its manifestation than it does in the ability to handle numbers. The persistence with which one follows a line of activity is due mainly to his capacity for forming habits in conjunction with his dominating interests. While the latter have no doubt heritable elements in what are usually known as "aptitudes," still they are affected by all sorts of extraneous influences. Such native qualities as pride, endurance, independence, obstinacy also have their role in its manifestation. When, however, it is remembered that small children show a wide range in this characteristic while imbeciles, who are incapable of conceiving a chain of related purposes, likewise show a wide range, this trait-complex may well be regarded as having heritable elements whose behavior may be profitably investigated.

The children from eighty matings to the number of 269 were classified into three groups, and the results compared with the theoretical expectation according to Mendel's Law.

	L	x	L	L	x	M	L	x	H
	L	M	H	L	M	H	L	M	H
Expected.	100			50	50			100	
Realized..	96^8	3^2		55^7	44^3		13^8	65^5	20^7

	M	x	M	M	x	H	H	x	H
	L	M	H	L	M	H	L	M	HW
Expected.	25	50	25		50	50			100
Realized..	12^8	82	5^2	5^5	60^8	33^7			100

Here again, there is some discrepancy between the actual and the theoretical results which may well be laid to difficulties in grading and the effect of exogenous elements on the manifestation of innate tendency. Making due allowance for these factors, the conclusion seems warranted that there are heritable elements in perseverance whose behavior is in accord with the principle of segregation.

CONSTRUCTIVE ASPECT OF SEGREGATION

Our histories furnish many interesting examples where there appears to have been an effective building up of trait combinations through fortunate matings in successive generations. Thus in line A, aggressiveness, perseverance, calculating ability and finally mechanical ability all converge from strains possessing these abilities to produce in the sixth generation unusual mechanical and mathematical aptitude, which with the

foregoing traits is bringing a high degree of success. Another significant series of combinations occurs in line C whereby defects concentrate in a single member of the third generation, who dies without issue, while the combination of medium or high aggressiveness and perseverance with calculating and other mental abilities produces average efficiency of various types in the later generations.

The recent extension of physical and mental tests in determining types of efficiency in the National Army, gives promise of far more accurate ratings in future studies of this kind. By such means this principle of segregation should be found capable of extension in directions at present unthought of. Such extension would provide a means of more accurate prediction as to the outcome of given matings and the trend of development in particular strains. Such extension would prove highly valuable for constructive eugenics.

The Immigration of Orientals

Cambridge, Mass., Mar. 8, 1918.

The Editor of the JOURNAL OF HEREDITY.

SIR: I should like to make one comment on the subject of Dr. Sidney L. Gulick's League for Constructive Immigration Legislation, which is referred to on page 379 of the December number of the JOURNAL. On paper, the principles of this new league read extremely well, and appeal to many persons who are seriously concerned regarding the probable future volume of immigration to this country. It should be pointed out, however, that it is an essential part of Dr. Gulick's program to repeal our present Chinese Exclusion Act; to end our present "Gentleman's Agreement" with Japan, and to have only one general immigration law. In other words, the plan is to treat all aliens alike, admitting Chinese and Japanese on the same terms as all other nationalities. While the number of Orientals to be admitted would necessarily be very small, for a time, under the proposed limitation to a certain percentage, these numbers would soon automatically increase. Furthermore, the percentages to be admitted could easily be raised. The Gulick plan also involves the naturalization of the Oriental.

It is these portions of the league's program which are strongly opposed by many persons who thoroughly believe in the restriction of immigration; and those who are interested in eugenics, and in the future character of the American race, may well bear these facts in mind. The Gulick plan proposes to put the thin edge of a wedge under the door which our national policy has built against Oriental immigration. It is a very thin wedge now, but it is a wedge.

R. DE C. WARD.

MUTATIONS IN THE JIMSON WEED

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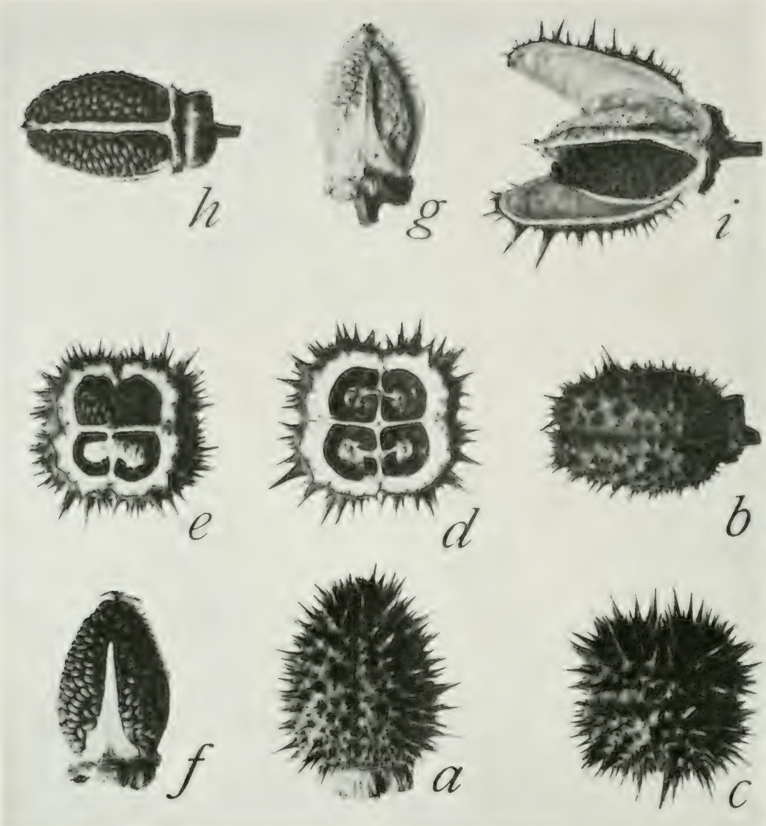
IN a recent article in the Journal of Heredity (March, 1917) the writers pointed out the availability of the common Jimson Weed (*Datura stramonium*) as an illustration of Mendelian phenomena. Data, in addition to those already published by Bateson and others, were reported showing the regularity with which the factors for purple and green stems and for spiney and smooth capsules followed the laws of segregation. The writers have recently determined the presence of another pair of factors affecting the node number and habit of the plant as is shown by the two specimens in Fig. 13. Aside from these three pairs of factors just mentioned and a possible fourth which is under investigation, no other Mendelizing factors, so far as we are aware, have been definitely determined for the Jimson Weed. During the past few years, however, we have discovered in our cultures a number of mutative variants of greater or less distinctness which, so far as studied, seem to be inherited in a manner different from that shown by simple Mendelian characters. We do not wish in this article to go into a detailed discussion of the method of their inheritance. Suffice it to say that these mutations are of sudden, though rather rare occurrence and transmit their characters—chiefly through the female sex—to only a part of their offspring. We desire here merely to present a few of the more marked types in order to give some idea of the extent of departure which they show from the normal. The mutations are distinguished from the normal plants from which they arise, not merely by single visible differences, but by a complex of characters which seem to be inherited as a whole wehn transmitted to their offspring. Leaf and capsule characters are perhaps the most conspicuously affected, although the growth habits and flowers are also involved in the mutations. The flowers, however, fail to show the marked range in color and morphological variation exhibited in many species. The mutations in Datura are distinguished by the same kind of differences apparently that characterize mutations in the classical genus Oenothera.

The capsule is perhaps the best part of the plant to serve as a single example of a given mutation. Its outline differs as seen from different sides. Fig. 5 is a photograph of capsules from a single normal plant arranged to show the internal structure and the resulting outlines in two positions. All the fruits are correctly oriented in relation to the central cross section. While in this section (d), cut midway between the base and the apex, two cross-walls apparently divide the ovary into four cells; the section at the left (c), cut higher up, shows that only a single septum extends completely to the apex. The capsule is in fact, therefore, two-celled with the placenta forming a false partition running part way to the top. The outline of the surface in consequence appears ovate on the placental side (a) and more nearly cylindrical or elliptical on the septum side (b). Typical examples are shown in Fig. 6 from two normal plants and from a number of mutations. At the top are two normals showing the spiney and spineless condition already explained as forming a

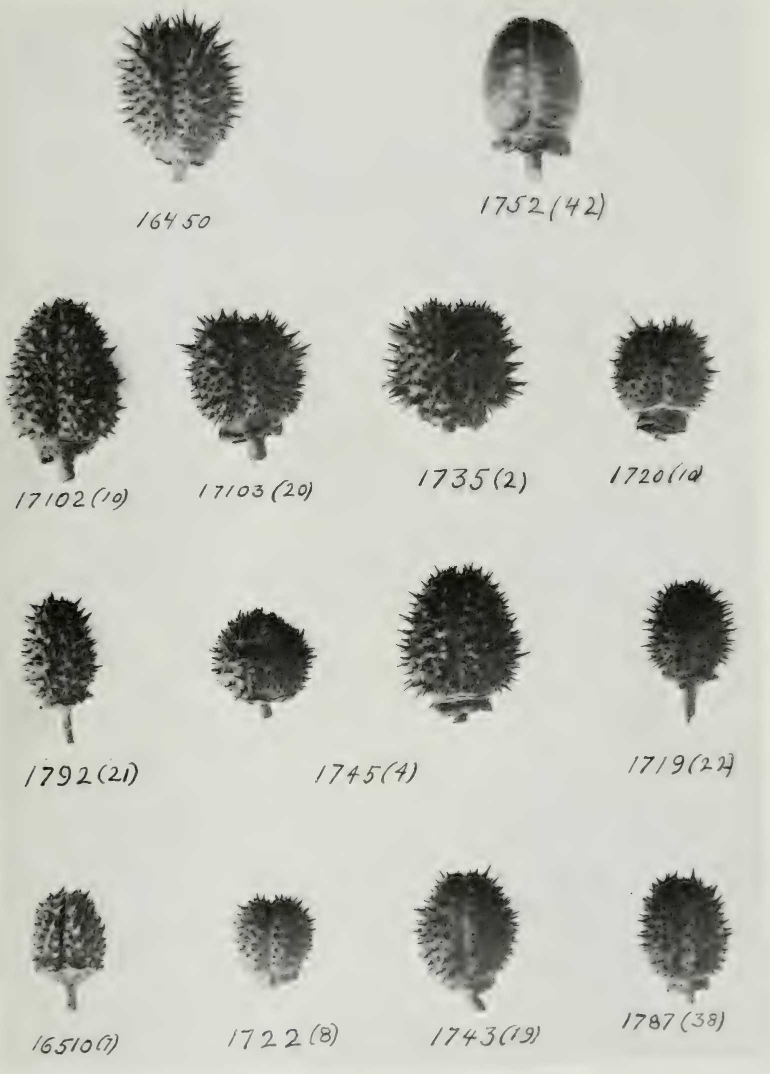
[1] Died in France, June 18, 1918, while in service in the Medical Detachment, 30th Infantry. Mr. Avery, while scientific assistant to the senior author, personally handled all the mutants discussed in this paper. It is largely due to the keenness of his powers of observation that they were discovered. He is also responsible for finding the first "Globe" mutant which started the investigation of variability in the Daturas.



CAPSULES FROM A NORMAL JIMSON WEED

These capsules are from a single normal plant and are arranged to show the internal structure and resulting outlines when seen from two different positions. Capsules of Jimson Weed correctly oriented in reference to central section. (*a*) Placental side showing ovate outline; (*b*) septum side showing elliptical outline; (*c*) top view; (*d*) cross section through middle; (*e*) cross section near apex leaving seeds intact on one side of septum and removed on other, exposing placenta; (*f*) placental side, outer walls removed, seeds intact; (*g*) the same, seeds also removed; (*h*) like (*f*) but septum side; (*i*) the same but seeds removed from one side and half of outer wall left intact. (Fig. 5.)

simple Mendelian pair in inheritance. The mutations on the three lower rows in Fig. 6 have been given provisional names taken chiefly from capsule or leaf peculiarities. Reading from left to right, we have on the second row from the top: "Sugarloaf" with characteristically shaped capsules and stunted spines: "New Species" with spherical capsules; "Globe" with globose, depressed capsules and stout spines; and "Glossy" with small shiny capsules. On the



CAPSULES OF VARIOUS FORM

At the top are two normal capsules showing the spiney and spineless conditions which form a simple Mendelian pair in inheritance. The mutations in the three lower rows have been given provisional names taken chiefly from capsule or leaf. (Fig. 6.)

NORMAL JIMSON WEED

Pot-grown normal plant shown for comparison with other plants. (Fig. 7.)

third line: "Cockelbur" with small nartow capsules; "Mutilated," two capsules, the one on left showing the usual mutilated condition of apex suggesting the name; and "Ilex" with small capsules and slender spines. On the fourth line "Tobacco-leaf" with small capsules and short stout spines; "Microcarpic" with small, rather downy capsules; "Buckling," a type related to "Microcarpic" but with larger more ovate capsules; and lastly an unnamed type not yet investigated.

Habit and leaf characters can best be shown by photographs of pot and field plants. A few selected mutations will be briefly described and illustrated by the accompanying photographs.

Polycarpic (Fig. 8).—The habit and leaf character of the mutant "Polycarpic" shown in Fig. 8 is strikingly different from the normal plant shown as a control in Fig. 7. The most conspicuous peculiarities are its narrow entire leaves and its slow growth. The name was given on account of the frequent presence of extra abortive carpels within the flower.

Globe (Fig. 9 and 10).—The "Globe" mutation was the first to be discovered, perhaps because it is one of the most distinct of the variant forms and shows in less degree than most of the mutants the lack of vigor seemingly characteristic of abnormal types in this as in other species. It was named on account of the depressed globose capsules already illustrated. The leaves are broader and less indented than normals and the foliage tends to be more compactly massed at the ends of branches. "Globe" mutants are recognizable at an early stage, frequently at or before the opening of the second leaves. Fig. 10 shows at the left a typical "Globe" seedling which, with its broader entire leaves is easily distinguished from the normal plant of the same age beside it.

Cocklebur(Fig.11and 12).—The"Cocklebur" mutant was so called because of the small, narrow capsules already illustrated. It was first recognized as

"POLYCARPIC" JIMSON WEED

The habit and character of this mutant is strikingly different from the normal plant shown in (Fig. 7). The most conspicuous peculiarities are its narrow entire leaves and its slow growth. (Fig. 8.)

a distinct type from its narrow, slightly toothed leaves. Fig. 8 is typical in habit for pot-grown plants inasmuch as the stems are weak and inclined to droop when grown under greenhouse conditions. In Fig. 12, a typical "Cocklebur" seedling is shown at the left beside a normal from the same pedigree. The differences are such that these mutants can usually be picked out in the seedpan.

"*Poinsettia*" (Fig. 14).—The mutant "Poinsettia" is one of the most distinct in habit of all the mutants so far discovered. Its long, narrow, dark-green leaves are clustered at the ends of the branches in a fashion suggestive of the plant from which it has been named. Masses of adventitious buds often extrude from the young stems, causing irregularities in the branching and increasing its strangeness of appearance. For comparison with this and the next mutant to be described, there is shown in Fig. 13 a few-noded normal plant on the left and a many-noded normal on the right.

"*N. S.*"—The original plant of the mutant provisionally designated by "N. S.," the initials of the words New Species, is represented in Fig. 15. This plant proved sterile in several attempted crosses with normals although fertile with itself and with its own offspring produced by self-pollination. Further tests have shown that the mutant differs from all others investigated in that it breeds true and seems to have established itself as a distinct new race which is almost entirely, if not absolutely, sterile with other forms. This physiological incompatability between a muta-

"GLOBE" JIMSON WEED

Named on account of the depressed globe capsules. The Globe was the first to be discovered perhaps because it is one of the most distinct of the variant forms. (Fig. 9.)

YOUNG "GLOBE" MUTANT. (Fig. 10.

ADULT "COCKLEBUR" MUTANT

It was first recognized as a distinct type by its narrow, slightly-toothed leaves. A typical pot-grown plant. Its stems are weak and inclined to droop when grown under greenhouse conditions. (Fig. 11.)

"COCKLEBUR" SEEDLING AND NORMAL SEEDLING

The "Cocklebur" seedling, at the left, is distinguishable from the normal seedling, at the right. (Fig. 12.)

TWO SPECIMENS OF JIMSON WEED

The common Jimson Weed furnishes a good illustration of Mendelian phenomena. Purple and green stems, spiney and smooth capsules obey the laws. A number of mutants have also been observed. Field-grown, many-noded normal on the right; few-noded normal on the left. (Fig. 13.)

THE MUTANT "POINSETTIA"

This mutant is one of the most distinct in habit of all the mutants so far discovered. Its long, narrow, dark-green leaves are clustered at the ends of the branches in a fashion suggestive of the plant from which it has been named. (Fig. 14.)

"NEW SPECIES" OR "N. S." MUTANT

This plant proved sterile in several attempted crosses. Tests have shown that this mutant differs from all others investigated in that it breeds true as a distinct new race. Here we appear to be witnessing the birth of a new species. (Fig. 15.)

tion and the parent species from which it arose suggests that we have actually been witnessing in our controlled pedigrees the birth of a new species which may be capable of maintaining itself in a mixed population uncontaminated by crossing with its ancestral line. The race is relatively vigorous. In some respects it resembles the "Globe" mutation, although not readily confused with the latter type. The leaves are considerably larger and the capsules, while roughly spherical in outline, are not so depressed at the apex nor armed with such stout spines.

We have shown in this brief presentation that the Jimson Weed possesses characters inherited in simple Mendelian manner; that, in addition, numerous mutations, several of which are figured, have arisen in our cultures; that these mutations transmit their characters as a complex, usually to only a part of their offspring, that the inheritance is chiefly through the female sex; that, in a single instance, a mutation has arisen which seems to have established a distinct race or new species, breeding true but seemingly unable to cross with the species from which it has had its origin.

Live-Stock Production Helped by County Agents in North and West

Production of more and better live stock with less expensive feed and greater profit to the producers is given attention by county agents in nearly every county in the thirty-three northern and western states.

During the fiscal year 1918 the agents assisted in the organization of 160 live-stock breeders' associations to encourage the use of better sires, and 182 cow-testing associations to eliminate unprofitable cows and bring about more economical feeding. Through these associations and those organized with the assistance of agents in previous years 127,835 cows were under test, resulting in at least 8,724 cows being discarded as unprofitable. Primarily, through these organizations, 10,986 farmers were induced to adopt balanced rations for their herds, and the following number of registered stock were secured at suggestion of agents: Bulls, 3,285; cows, 4,836; rams, 1,469, and boars, 2,974. The agents also brought about the transfer to other herds of 3,370 valuable registered sires by means of information given to individual farmers or through exchange lists published by the farm bureaus.

In some states a special effort was made to save calves from being slaughtered for veal, resulting in 10,499 additional calves being raised. This work was carried on most extensively in Wisconsin, from which 2,459 calves from high-grade or registered stock were shipped for breeding stock to Missouri, Wyoming, and other western and southern states.—*Weekly News Letter, U. S. Dept. of Agriculture.*

THE DETERMINATION OF DISPUTED PARENTAGE AS A FACTOR IN REDUCING INFANT MORTALITY

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While juries have been called upon to compare in court the features of children and alleged parents, the uncertainty of such superficial comparisons has prevented any important legal use of the determination of parentage. The most widely known of such cases have been in cases of contested wills or titles. These cases, while spectacular, represent only a small part of the very wide application that would be made of this method, were it possible to unerringly establish parentage in illegitimacy cases. At the present time, if an illegitimate mother sues an alleged father for the support of her child, the defense on his part is usually that some other person might have been the father of the child, and because of difficulty of rebutting this defense under the present methods, it has been very difficult to fasten the support of the child on the father. If it is possible to elaborate methods by which parentage can be surely determined, so that alleged parentage can be definitely proven or disproven, then the support of the child can be fastened upon the father in cases where he can be located and has the necessary income.

The admissibility of the child for the inspection[1] of the jury is now well established for children over two[2] years of age, but the preponderance of decisions excludes this evidence for establishing resemblances below that age, on the ground that the child's features have not yet acquired maturity and permanence. In our present state of knowledge this rule can be little criticized, but

[1] For admissibility of child for inspection:
Gilmanton *vs.* Ham, 38 N. H., 108.
State *vs.* Arnold, 13 Ired. (N. C.), 184.
Finnegan *vs.* Dugan, 96 Mass., 197.
State *vs.* Woodruff, 67 N. C., 89.
Morrison *vs.* People, 52 Ill. App., 482.
State *vs.* Smith, 6 N. W., 153. (2 years 1 month.)
Scott *vs.* Donovan, 26 N. E., 871. (Regardless of age.)
Gaint *vs.* State, 14 Atlantic, 600.
Kelly *vs.* State, 133 Ala., 195.
Shailer *vs.* Bullock, 78 Conn., 65. (10 months.)
Higley *vs.* Bostock, 79 Conn., 97.
State *vs.* Sardell, 46 A., 1083.
Brantley *vs.* State, 65 Ia., 678.
Lard. *vs.* State, 1055 W., 90.
Sins *vs.* State, 84 S. E., 976.
State *vs.* Browning, 152 P., 672.
Smith *vs.* Hawkins, 47 S. O., 429.
Commonwealth *vs.* Pearl, 33 Pa. Super. Ct., 97.
Robnett *vs.* The People, etc., 16 Ill. Appellate Court, 299.

[2] Against admitting a very young child:
Clark *vs.* Bradstreet, 80 Me., 454. (6 weeks old.)
Hanawalt *vs.* State (1885), 64 Wis., 84. (Younger than 1 year.)
Overlook *vs.* Hall, 81 Maine (1889). (6 months old.)
State *vs.* Harvey, 84 N. W., 535. (9 months old.)
State *vs.* Danforth, 48 Iowa, 43. (3 months old.)
Rush *vs.* State, 19 Indiana, 152. (3 months old.)
Ingram *vs.* State, 37 N. W., 943.
Shorter *vs.* Judd, 42 Pacific, 337. (At an age when its features have not assumed some degree of maturity and permanence.)

it is evident that it is while the child is still below two years that it is most necessary that the parentage should be established so that the child shall be supported. Since the objections of the court are solely based on the uncertainty of determination by mere inspection, there is every reason to believe that should a method be developed that would make the determination possible from birth onward, that the courts would interpose no objection.

However, we have so far considered the admissibility of the child itself as an exhibit. There remains the question of the admissibility of the opinion of persons as to the alleged resemblance. In two cases photographs[3] have been admitted, but the courts have been very reluctant to admit the judgment of witnesses,[4] and the preponderance of the decisions is against their admission. Yet we have three cases in which there is clear discrimination as to the ability of witnesses to reach an opinion of value. I shall quote the language of the courts in these cases, Clark *vs.* Bradstreet, 80 Me., 454: "The testimony of witnesses where they have no special skill or knowledge in such matters has never been admitted in the state (Maine)." Eddy *vs.* Gray, 4 Allen, 438. "The evidence she offered as to the supposed resemblance of the child to the defendant was properly rejected. It is not of the kind which comes within the rule in relation to the testimony of experts upon questions of science or of skill or of knowledge acquired by some peculiar experience or education. The witness called did not profess to have any special skill upon the subject of inquiry." Keniston *vs.* Rowe, 16 Me., 38. "Witnesses who have had sight of the persons might be indefinitely multiplied, without affording any satisfactory ground of judgment for a jury. Witnesses except in some art, trade or profession requiring peculiar skill and science are not called to form comparisons and to testify to opinions arising from them."

It is quite evident therefore that the court has already laid the ground for real expert testimony on this subject when methods that yield reliable results shall have been elaborated. The reasons why the elaboration of such methods would be so desirable are the following: (1) The number of illegitimate children will be cut down, if the prospective father knows that his paternity can be detected and the support of the child fastened upon him. Second, the care of the child would be very much better and hence its mortality risk appreciably reduced. This we may conclude from the well-known contrast between the death rate of illegitimate and legitimate children, most of which must be attributed to the better support of the latter class. Having, then, seen the great need for such a method, let us examine our knowledge of heredity to see whether such a method is feasible.

There are four distinct methods that might be employed, and while the

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Photograph was admitted and bearing on resemblance.
State *vs.* Patterson, 100 N. W., 162.
Shorter *vs.* Judd, 42 Pac., 337.

[4] State *vs.* Woodruff, 67 B. C., 89. (It allows all persons to testify to such identity or to such resemblance who have had an opportunity of seeing the persons, if but for an instant.)
Douglas Peerage Case, House of Lords, 1769.
Day *vs.* Day, Huntington Assize, 1797.
Paulk *vs.* State, 52 Ala., 427. (The defendant may prove that the child bears no likeness to him or that it resembles another man who had opportunity of illicit intercourse with the mother.)
Jones *vs.* Jones, 45 Mary, 151. (1876.)
Keniston *vs.* Rowe, 16 Maine, 38.
Eddy *vs.* Gray, 4 Allen, 435.
W. Calman *vs.* State, 49 S. E., 612.
Shorter *vs.* Judd, 42 Pacific, 337.
Hanawalt *vs.* State, 64 Wis., 84.
Keniston *vs.* Rowe, 16 Mo., 38.
Young *vs.* Makepeace, 103 Mass., 50. (We think also that the testimony to show points of similarity between the child and the parent should not have been admitted; even where there is a noticeable resemblance there may be equally marked points of dissimilarity.)

method to be mentioned last is believed by the writer to be the method of greatest reliability, the first three methods to be mentioned will have some corroborative value, especially in giving more concrete evidence to skeptical jurors in the first few years of the application of the method.

1. The alternative inheritance of many abnormalities. Davenport in his "Heredity in Relation to Eugenics" has a list of many abnormalities which are inherited alternately and in a more or less Mendelian manner. In those cases where there is present one of these abnormalities in both the suspected parent and the child, we have corroborative evidence, but this method alone can be of limited use only.

2. More uniform application of the alternative inheritance of certain human traits which are inherited in a more or less Mendelian fashion, such as hair, eye and skin color. Since there is always some color, this comparison is possible in all cases, in contrast to the first class where the abnormality is only occasionally present. Conclusive evidence is hardly to be expected, although the evidential value becomes greater where both parent and child had some one recessive characteristic. It is true that there is a court decision where evidence as to eye color[5] was ruled out, and a similar one in respect to hair color, but it is evident that the judge's reason in each case was not that these traits were thought by him not to be inherited in some degree, but a justifiable fear lest this evidence alone might too greatly influence the jury, in view of the importance of reaching conclusions as to parentage only on the basis of many traits.

3. The papillary ridges of the palm and sole. Prof. H. H. Wilder, of Smith College, and other workers have now well established that there is a large rôle of heredity in the determinations of the patterns of these lines on the palm and sole. These are the lines so well known in the finger prints now so frequently taken for identification purposes. I can vouch for this because I have on the palm of one of my hands one peculiar feature of the palm pattern common to my mother, myself and my older son. The use of the palms and soles is decidedly superior to the class of evidence heretofore discussed, but since it does not lend itself as yet readily to statistical analysis, we must look mainly to the last method, the anthropometric.

Anthropometry, or the science of human measurements, offers us the main reliance because by taking one hundred measurements on the child, on the suspected parent, and on the known parent, if the other parent be known, it will be possible to establish an index of correlation which will run very much higher in the case of real parentage than where there is no relation. The one hundred measurements to be taken should include a number on the ear, for the reason that this organ is peculiarly unsusceptible to modifications and to change in its proportions during life. Where the ear has been pierced, the lobal characteristics should be rejected, and possibly also the amount of projection from the head should be rejected as having too much of the modification element. Head shape and facial features should be used for a large number of measurements because of their remarkable variability. The other measurements would be those where the measurement is primarily a skeletal one, little affected by the weight and health of the individual. Davenport has shown that different skeletal dimensions may be inherited independently. There are two disturbing factors which should be recognized. One is the change in proportion between male and female. This is readily provided for by the use of correction factors which eliminate sex differences. A more disturbing element is change of proportion with age, but this again can be largely eliminated by the use of correction factors.

There remains now to discuss the feasibility of this method. In the first place, a large number of measurements must first be made on parents and their

[5] People *vs.* Carney, 29 Hun. (N. Y.), 47, 49 (1883). (Evidence of the color of the child's eyes is not admissible to show its paternity.)

children in order to establish norms and correction factors, and also to determine the amount of difference in the correlation indices where the parental relation exists and does not. An appropriation of $35,000 could be depended upon to give results in two years. The method of attack is well understood by competent students of heredity, and it merely requires the decision of some institution to undertake the investigation. The writer suggests that the Children's Bureau at Washington would be the best agency, but since the governmental initiative is sometimes difficult to invoke, it may be possible that we must look to the Carnegie Institute of Washington or the Rockefeller or the Sage foundation for the preliminary work.

After the methodology has been perfected, how shall the method be actually used? It is my belief that this work should not be done by private experts hired by one or the other of the litigants, the system by which expert witnesses are usually employed, but which is nearly universally disapproved by those who have given the matter attention. Better, let the court call upon the Disputed Parentage Division of the Children's Bureau to make the determination and report to it, the Children's Bureau making an appropriate charge to the court for the services. By eliminating the danger of bias, this will greatly increase the confidence of judges and juries in the decisions.

Rabbit Raising Pays in Utah

In Utah many boy and girl club members are going into the rabbit-raising business, finding it most profitable, according to word received by the States Relations Service, United States Department of Agriculture. They have found that it costs about 25 cents to raise a rabbit to the age of three months, and that at that time it may be marketed at 35 or 40 cents a pound. The pelts bring from 15 to 75 cents, depending on the kind of rabbit and its size. Compared with poultry, rabbit raising in Utah has proved much more economical, as rabbits are very hardy and require no expensive feed. For example, one club boy reports that he feeds only oats, cabbage, and water. In some places in the state the demand exceeds the supply. Hotels and restaurants, which serve rabbit as often as they do chicken, are the chief buyers. The Bureau of Biological Survey and the Bureau of Markets are coöperating actively in developing interest in the production and marketing of domesticated rabbits and in standardizing methods of handling these animals and the wild rabbits which are killed for sport or to protect crops from their depredations.—*Weekly News Letter, U. S. Dept. of Agriculture.*

Boys Teach Fathers Better Hog Raising

Some of the boys in the two Dekalb County, Ind., pig clubs are showing their fathers how rapid and economical gains can be made in raising pigs. Under the direction of the local county agent these boys have been able to almost double the results obtained by their fathers within the same length of time and feeding pigs of the same litter. The boys used self-feeders and the fathers did not, and the pigs which were allowed to select their own feed made gains of 2 pounds a day. The club members are proving, beyond question, the merits of the self-feeder, and hog raisers in the county of many years' experience are beginning to copy the boys' methods. As a result of the club work, the county agent reports, many fathers and sons are now planning to go into partnership and raise purebred hogs.—*Weekly News Letter, U. S. Dept. of Agriculture.*

IMMIGRATION RESTRICTION AND WORLD EUGENICS

Prescott F. Hall

THERE is one aspect of immigration restriction in the various countries which does not often receive much attention, namely, the possibility of its use as a method of world eugenics. Most persons think of migration in terms of space,—as the moving of a certain number of people from one part of the earth's surface to another. Whereas the much more important aspect of it is that of a functioning in time.

This comes from two facts. The first is that the vacuum left in any country by emigration is rapidly filled up through a rise in the birth rate. There are more people in England today than in the time of Elizabeth, in spite of the enormous emigration from that country, to all parts of the world; and there are just as many sparrows in England today in spite of the unfortunate spread of those birds in the United States. The vacuum is chiefly filled by the breeding of the lower classes. The vacuum is chiefly filled by the breeding of the lower classes. Thus, according to Professor Pearson, more than one-half the births in England are now from the lowest one-sixth of the population. In Italy, a similar condition fills the vacuum left by the very large emigration from there to North and South America.

The second fact is that immigration to any country of a given stratum of population tends to sterilize all strata of higher social and economic levels already in that country. So true is this that nearly all students of the matter are agreed that the United States would have a larger population today if there had been no immigration since 1820; and, it is needless to add, a much more homogeneous population. As long as the people of any community are relatively homogeneous, what differences of wealth and social position there may be do not affect the birth rate, or do so only after a considerable time. But put into that community a number of immigrants, inferior mentally, socially and economically, and the natives are unwilling to have their children associate with them in work or social life. They then limit the number of their children in order to give them the capital or education to enter occupations in which they will not be brought into contact with the new arrivals. This result is quite apparent in New England where successive waves of immigration from lower and lower levels have been coming in for eighty years. In the west, the same New England stock has a much higher birth rate, showing that its fertility has in no way diminished. In the south, where until very recently there was no immigration at all, and the only socially inferior race was clearly separated by the accident of color, the birth rate has remained very high, and the very large families of the colonial period are even now not uncommon.

This is not to say that other causes do not contribute to lower the birth rate of a country; for that is an almost world-wide phenomenon. But the desire to be separated from inferiors is as strong a motive to birth control as the desire for luxury or to ape one's economic superiors. Races follow Gresham's law as to money; the poorer of two kinds in the same place tends to supplant the better. Mark you *supplant*, not drive out. One of the most common fallacies is the idea that the natives whose places are taken by lower immigration are "driven up" to more responsible positions. A few may be pushed up; more

are driven to a new locality, as happened in the mining regions; but most are prevented from coming into existence at all.

What is the result then of the migration of a million persons of lower level into a country where the average is of a higher level. Considering the world as a whole, there are, after a few years, two million persons of the lower type in the world, and probably from half a million to a million less of the higher type. The proportion of lower to higher in the country from which the migration goes may remain the same; but in the country receiving it, it has *risen.* Is the world as a whole the gainer?

Of course, the euthenist says at once that these immigrants are improved. We may grant that, although the improvement is probably much exaggerated. You cannot make bad stock into good by changing its meridian, any more than you can turn a cart horse into a hunter by putting it into a fine stable, or make a mongrel into a fine dog by teaching it tricks. But such improvement as there is involves time, expense and trouble; and, when it is done, has anything been gained? Will anyone say that the races that have supplanted the old Nordic stock in New England are any better, or as good, as the descendants of that stock would have been if their birth rate had not been lowered?

Further, in addition to the purely biological aspects of the matter, there are certain psychological ones. Although a cosmopolitan atmosphere furnishes a certain freedom in which strong congenital talents can develop, it is a question whether as many are not injured as helped by this. Indeed, there is considerable evidence to show that for the production of great men, a certain homogeneity of environment is necessary. The reason of this is very simple. In a homogeneous community, opinions on a large number of matters are fixed. The individual does not have to attend to such things; but is free to go ahead on some special line of his own, to concentrate to his limit on his work, even though that work be fighting the common opinions. But in a community of many races, there is either cross-breeding or there is not. If there is, the children of such cross-breeding are liable to inherit two souls, two temperaments, two sets of opinions, with the result in many cases that they are unable to think or act strongly and consistently in any direction. The classic examples are Cuba, Mexico and Brazil. On the other hand, if there is no cross-breeding, the diversity exists in the original races, and in a community full of diverse ideals of all kinds much of the energy of the higher type of man is dissipated, and in two ways. First, in the intellectual field there is much more doubt about everything, and he tends to weigh, discuss and agitate many more subjects, in order to arrive at a conclusion amid the opposing views. Second, in practical affairs, much time and strength have to be devoted to keeping things going along the old lines, which could have been spent in new research and development. In how many of our large cities today are men of the highest type spending their whole time fighting, often in vain, to maintain standards of honesty, decency and order, and in trying to compose the various ethnic elements, who should be free to build new structures upon the old!

The moral seems to be this: Eugenics among individuals is encouraging the propagation of the fit, and limiting or preventing the multiplication of the unfit. World eugenics is doing precisely the same thing as to races considered as wholes. Immigration restriction is a species of segregation on a large scale, by which inferior stocks can be prevented from both diluting and supplanting good stocks. Just as we isolate bacterial invasions, and starve out the bacteria by limiting the area and amount of their food supply, so we can compel an inferior race to remain in its native habitat, where its own multiplication in a limited area will, as with all organisms, eventually limit its numbers and therefore its influence. On the other hand, the superior races, more self-limiting than the others, with the benefits of more space and nourishment will tend to still higher levels.

This result is not merely a selfish benefit to the higher races but a good to the world as a whole. The object is to produce the greatest number of those fittest not "for survival" merely but fittest for all purposes. The lower types among men progress, so far as their racial inheritance allows them to, chiefly by imitation and emulation. The presence of the highest development and the highest institutions among any race is a distinct benefit to all the others. It is a gift of psychological environment to anyone capable of appreciation.

It is important, therefore, that nothing in the constitution of the League of Nations should limit the right of any nation to decide who shall be admitted into its life; for, as Le Bow says, a preponderance of foreign elements destroys the most precious thing it possesses—its own soul.

TWO STRIKING COLOR VARIATIONS IN THE GREEN FROG

P. W. Whiting
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IT IS well known to every student of pond life that the common green frog, Rana clamitans Latrielle, show many variations in color. Typically, the coloring is bright metallic-green on head and shoulders and dusky olive, more or less spotted, posteriorly. The throat is orange-yellow in the male, white in the female.

The dark coloration of frogs is due to a layer of black pigment cells under the epidermis. Under the influence of various stimuli, these cells have the power of changing shape. Expansion produces a dark color, contraction a dilution effect. Mary C. Dickerson, in *The Frog Book,* explains the production of green color as follows:

"Green color is not produced directly by a pigment, but as the result of black and yellow pigments and a structure, namely, the so-called interference layer. This is a single layer of polygonal cells between the epidermis and the black pigment layer. These cells contain minute yellow particles, which crowd to the sides of the cells next the epidermis. If these cells were empty, the result would be simply that the black pigment layer would be farther from the surface and would be seen through the interference layer. This would make the color appear blue instead of black, giving the ordinary color phenomenon of dense media, as seen in the color of the sky (*i. e.,* all the light waves of great wave lengths are absorbed and only those of short lengths are reflected). When the interference cells contain yellow, the blue is seen through the yellow, and the resultant color is green.

"The green color thus produced may be more blue or more yellow, and may change to brown when the black pigment cells expand greatly and press close about the cells of the interference layer, thus diminishing the density. A fragment of the outer skin of a green tree frog, examined from underneath, of course appears black, because we are looking directly at the black pigment layer. The same piece looked at from above and against the light appears brown, but examined from above with light from above it appears green and shows the polygonal cells of the interference layer.

"Therefore, frogs that have the interference layer and black and yellow pigments appear green or brown, and can change from one to the other with great rapidity."

The same principle of color produc-

tion is illustrated by blue or greenish eyes in man, by greenish eyes in cats, and by the blue-eyed white cat. Thus the blue eye has dark pigment on the posterior side of the iris, while in the greenish eye there is a certain amount of yellow pigment on the front of the iris as well. The blues seen in many birds and butterflies are similarly due to the presence of dark pigment underlying modifying structures, and greens are produced by the addition of yellow pigment.

CREAMY WHITE FROGS

The two color variations in the green frog, with which the present paper is concerned, were noticed in specimens brought to the zoölogical laboratory of the University of Pennsylvania in the fall of 1916. Yellow pigment was entirely lacking from the skin, and the dark pigment was reduced to a very light sepia, barely visible on the back and head. The skin in general appeared creamy white. The iris was black, showing that, while the yellow pigment normally present was eliminated, the black was here reduced but little, if any. The pupil was dark.

This variation is apparently comparable to that described by Haecker[1] in the tiger salamander. He found partially albinic forms which showed more or less gray color in the skin. Yellow pigment was lacking. The iris was in all cases black, but, unlike that of the albinic frogs, the pupil was reddish, due to reduction of the dark pigment in the retina. The variation described by Haecker acted as a simple Mendelian recessive.

ALBINO FROGS

The other variation in the green frog was represented by a single specimen, which was brought to the laboratory in the fall of 1917. This was a young frog lacking black pigment entirely. The skin of the back, sides and head was clear light yellow. The only trace of a darker color was a very slight greenish shade in the skin about the eye. The iris was clear gold; the pupil, pink.

Dr. Sewall Wright, in an interesting series of articles on color inheritance in mammals,[2] has developed the theory that there are two enzymes for color production. "Enzyme I" is the fundamental enzyme, which, acting alone on chromogen, produces yellow pigment. "Enzyme II" has no effect on chromogen directly, but in combination with "Enzyme I" develops dark pigment. It appears quite probable to me that Wright's theory may be extended to other groups, such as birds, amphibia, and insects.

The albinic variation in the tadpoles here described, as well as in Haecker's salamanders, would then be due to a factor determining extreme, though not complete, reduction in "Enzyme I." The yellow frog, on the other hand, would have "Enzyme II" almost entirely eliminated. If the whitish forms differed from the normal variety by the loss of a certain color factor, C, and the yellow differed by the loss of a dark color developer, D, they would reconstitute the common form when crossed. Thus albino, ccDD, by yellow, CCdd, gives normal, CcDd. If these were inbred, we should obtain nine (CD) normal, three (ccD) albinic, three (Cdd) yellow, and one (ccdd) which, lacking both factors, should be pure white with pink iris and pupil, for cc eliminates all yellow and dd eliminates all black and brown. It is unfortunate that the specimens could not be reared and tested, but it has seemed worth while, in view of the striking character of the variations noted and the apparent correlation with color factor differences in mammals, to put the matter on record. The writer would be interested to hear of other similar variations.

[1] Haecker, V. 1911. Allegemeine Vererbungslehre. Friedr. Vieweg & Sohn, Braunschweig.

[2] Wright, Sewall: "Color Inheritance in Mammals," JOURNAL OF HEREDITY, Vols. viii and ix, 1917-18.

BUD VARIATIONS IN SUGAR CANE

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THE occurrence of bud mutations in cultivated plants has long been known and the commercial value of many such forms has been recognized. Several hundred bud varieties of fruits, flowers, and other plants grown for their economic or ornamental value are in more or less general cultivation at the present time. As examples of such varieties mentioned may be made of the Washington Navel orange, the Pima cotton and several forms of the Nephrolepis fern.

A recent study of plant varieties known to have originated as bud mutations disclosed the importance of such forms in the development of the cane sugar industry. The following account of the bud origin of several sugar-cane varieties is presented in the hope that it may reach a wider distribution among students of genetics than was secured by the publications reviewed, *i. e.:* (1) *The West Indian Bulletin*, vol. 2, No. 3 (1901 or 1902), pp. 216-223, "Bud Variation in the Sugar Cane." (2) "Cane Sugar," Noel Deerr, London, 1911, pp. 23-38.

Anyone especially interested in this subject should consult these articles, as Mr. Deerr's book has colored plates of several of the bud-varieties described and the figures reproduced herewith are shown in color in the *West Indian Bulletin.*

Sugar cane *(Saccharum officinarum* Linn.) is one of the most important of our economic crops, and yet the development of the scientific study of it dates back but little over a generation. This is probably due largely to the confinement of its cultivation to widely scattered districts, most of which are remote from the older centers of civilization and to the decentralized development of the industry.

Previous to 1885 it was generally believed that the flowers of the sugar cane were infertile, notwithstanding that there are several earlier recorded instances of the occurrence of seed. All propagation was by the planting of joints of the stalks, and it is believed that practically all the varieties in commercial cultivation up to within the last twenty-five years originated as bud variations.

Since the rediscovery of the fertility of the flowers of the sugar cane, which was made independently by Soltwedel in Java in 1888, and by Harrison and Bovell in Barbados in 1889, valuable varieties have been developed as seedlings. Commercial propagations are still made entirely by planting pieces of the stalk. Seed propagation is only practiced in the search for new varieties, as seedlings show the characters of their parents in but very slight degrees.

VARIATIONS FROM STRIPED VARIETIES

The earliest recorded instance of bud variation in the sugar cane is given by Mr. J. F. Horne,[1] then Director of Forests and Botanical Gardens in Mauritius. In describing canes imported into Mauritius he wrote: "Two plants were found, one of which, while producing striped canes from one eye, produced green canes from another eye, both of which eyes belonged to the same piece of cane, while the second plant

[1] The magazine *Sugar Cane*, No. 17.

Bud variation in sugar cane found on the Kirton plantation, Barbados. From West Indian Bulletin, Vol. 2, No. 3. (Fig. 16.)

produced both striped and green canes from one and the same eye."

A very similar observation was made by Melmoth Hall[2] a little later. He wrote: "I have in one instance seen no less than three distinct canes springing from one stool of the ribbon variety, one entirely yellow, one entirely green, the other being the usual ribbon cane; while from other stools in the same field I found canes either of a uniform green, purple or purplish-brown; all the rest spring from the same ribbon cane root, being striped in the usual way."

Mr. Deerr, writing in 1910, said that for generations the Louzier (Otaheite) cane, known under several names in different sections, had produced a very large proportion of the world's supply of sugar cane combining the characteristics of heavy tonnage, sweet and pure juice, and low fiber content. M. Auguste Villele, of Mauritius, thus described the origin of this variety in a letter to Mr. Deerr: "In 1868 or 1869 M. Lavignac introduced into Mauritius several varieties of cane from New Caledonia, among which was the Mignonne, a red and green striped variety. This cane was noticed by M. Louzier to throw sports and from a yellow sport the Louzier was developed, being the standard cane of Mauritius for many years."

The Louzier cane traveled from Mauritius to other districts and is not to be distinguished from the Yellow Otaheite cane of Cuba and Java, or from varieties grown under other names in several sugar-cane districts. Mr. Deerr states that, having seen the Bourbon, the Lahaina, and the Louzier growing on a large scale in Demerara, Hawaii, and Mauritius, he has no hesitation in saying that they are indistinguishable. Stubbs[3] and Harrison and Jenman[4] also considered these varieties identical. It is then reasonable to suppose that the Lahaina and Bourbon canes, although introduced into Hawaii and the West Indies as self-colored canes, were originally in Otaheite sports from the cane introduced into Mauritius in 1868 or 1869 under the name Mignonne, and that in Otaheite the latter was cultivated as a separate cane.

Assuming the identity of the Louzier with the Otaheite and Lahaina canes as described above, and remembering the origin of the first mentioned, it is also probable that the other two originated in the same way but, having been introduced at early dates as self-colored canes, no suspicion of their origin arose. The Louzier cane also is known to throw a striped sport indistinguishable from the Mignonne from which the Louzier arose, and this cane in turn throws self-colored sports, thus completing the cycle through striped cane, self-colored cane, to striped cane again, although it is impossible to state which was the original type.

In December, 1890, Mr. J. F. Horne wrote the Director of the Royal Gardens at Kew as follows:[5] "Of new varieties originating as bud sports we have eight or nine in Mauritius alone; some of them are very fine canes and they are extensively planted. Most of them are hardier than their parents and they yield more sugar. They are mostly obtained from new canes recently introduced. The sudden change of climate, soil, and other circumstances cause them to be thrown off. More of them might be obtained if the planters were more observing than they are and closely followed the cane cutters throughout their fields. As things are, a new variety is only observed should it chance to spring up in an outside row."

In the early nineties the Striped Tanna canes. Under th name of Yelcolor) was brought to Mauritius, and it was frequently observed to throw sports whence have come the White

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[2] The magazine *Sugar Cane*, No. 64.
[3] Dr. W. Stubbs, *Sugar Cane*, 1897, p. 66.
[4] The magazine *Sugar Cane*, No. 273.
[5] Kew Bulletin, 1891.

Stool of Red Ribbon (Striped Cheribon) sugar cane showing stalks of the Burke or White Cheribon variety appearing as a bud variation. Found by Mr. S. B. Kirton, owner of the Arthur Seat plantation, Barbados, in 1900. From West Indian Bulletin, Vol. 2, No. 3. (Fig. 17.)

(yellow color) and Black (purple color) Tanna canes. Under the name of Yellow Caledonia the White Tanna in 1910 formed the major portion of the unirrigated plantings in the Hawaiian Islands, as Malabar it was the favorite cane of Fiji, and as White Tanna it covered extensive areas in Mauritius. All three of the Tanna canes were also cultivated on a large scale in Australia.

Mr. James Clarke of North Queensland reported that the first instance of bud variation that he noticed was in New South Wales, where he had charge of a large sugar plantation. Having planted with his own hands some of the Striped Tanna cane in an endeavor to establish there a variety resistant to the "gumming" disease, he noticed when cutting the canes that some of them were entirely yellow and some purple without stripes. One stalk was found with the three lower joints striped like Striped Tanna and the upper portion of the stalk unstriped and completely yellow. The yellow and the purple canes were planted separately, as were the joints from the stalk that was partly striped and partly yellow, and in each case the resulting canes were true to the color of the cuttings planted.

The following experiment[6] is reported from Louisiana: "As an illustration of bud variation, some stalks of cane, partly white and partly purple, were selected from the field of Soniat Bros., Tchoupitoulas plantation. They were called bastard canes. These stalks were planted as follows: First row, the entire stalk; second row, the white joints; third row, the colored joints. At the end of the season four distinct canes, as far as color could direct us, were obtained. Types of the four new varieties were selected and separately planted and the next year were found to be nearly pure. Selection and separate plantings have been made each year since. These canes have been named as follows: First, a white cane, No. 29, Soniat; second, a light striped cane, No. 59, Nicholls; third, a light purple cane, No. 64, Bird; fourth, a dark striped cane, No. 65, Garig. The yield and analyses of these canes have been annually made. They, except the white, are entirely different from any other cane in our collection."

An interesting bud variation (Fig. 1) was forwarded by the Hon. F. J. Clarke from Kirton plantation in Barbados to the West Indian Department of Agriculture and was exhibited by Dr. Morris, the Commissioner of Agriculture, at a meeting of the Barbados Agricultural Society in April, 1899. The specimen was a ribbon cane with very pronounced stripes on the main stem. Four successive joints had thrown off shoots, the first and third of which were striped with red like the parent cane, while the second and fourth were unstriped yellow canes. The resulting appearance was a striped parent cane bearing two striped shoots on one side and two unstriped shoots on the other side.

In March, 1900, Mr. S. B. Kirton, proprietor of the Arthur Seat plantation, Barbados, observed several stools of cane showing bud variation growing in the outside row of a field on his estate. From a common base sprang red striped canes on one side and pale yellow unstriped canes on the other side (Fig. 2). An examination of five clumps in which the phenomenon was noticed gave the following figures:

Stool	*White canes*	*Red striped canes*
1	6	6
2	9	6
3	6	4
4	5	6
5	1	16

The cane originally planted was determined in each case to have been Red Ribbon (Striped Cheribon, yellow and blood red color). In one clump which was examined carefully it was found that a bud of the striped cane which was planted had produced a white cane which in turn produced a ribbon cane from a bud below the surface of the ground. The white canes were identical

[6] Dr. W. Stubbs, *Sugar Cane*, 1897, p. 66.

with the Burke variety (White Cheribon, yellow-violet color).

Subsequent to these investigations Mr. James Clarke, of North Queensland, recorded the following instances of bud variation in a letter to Prof. J. B. Harrison, of the West Indian Department of Agriculture. In cutting Striped Singapore canes (Striped Cheribon) a short time previous he had noticed what appeared to be ripe, yellow Rappoe canes (Burke or White Cheribon) growing out of the middle of the Striped Singapore stools. Some stalks were found with purple stripes on a few of the lower joints, while the upper part of the stalk was of a uniform yellow color. Careful search showed that the canes planted had really been of the Striped variety. To make sure that the yellow canes growing from the center of the Striped Singapore stools were true sports, a stool of mixed canes was dug and sliced through the center. This showed that the striped canes were the parents of the yellow sports which had sprung from them.

There seems no reason to doubt that the White and Black Cheribon canes originated as variations from the Striped Cheribon, and they are repeatedly found appearing as sports of that variety. These canes have been introduced into nearly all cane-growing districts, and as sugar producers they are equal in value to the Otaheite.

It is important to note that when a striped cane throws sports two varieties arise, one light colored and one dark colored, and that almost always the light-colored and the dark-colored canes arising from any one variety are identical. Thus almost every light-colored sport from a Striped Tanna cane is a White Tanna, and nearly every dark-colored sport from a Striped Tanna is a Black Tanna.

VARIATIONS FROM SELF-COLORED VARIETIES

Sporting from self-colored canes has been less frequently observed than from striped canes, but some self-colored canes have been known to give rise to two distinct striped bud variations. In Mauritius the Louzier (yellow color) has been known to throw two distinct sports, one a cane identical with the Mignonne (red and green striped), the parent of the Louzier, and the other the Horne (irregularly striped red, green and yellow). Mr. Deerr also observed similar sports springing from the Otaheite cane under the names of Bourbon and Lahaina in Demerara and Hawaii.

The Horne cane just mentioned is of especial interest as its appearance was one of the earliest, if not the earliest, recorded instance of a striped cane originating from a self-colored one. It was first found by Mr. J. F. Horne springing from a plant of the Louzier variety and has been grown on the plantation scale in Mauritius. A cane exactly similar to the Horne has been observed several times in Bourbon (Louzier or Otaheite) fields in Demerara.

The Green Rose Ribbon cane is a green and yellowish-pink striped variety which originated as a sport of the Otaheite or Louzier and is grown with success in Australia.

Another instance of a bud variation of this same character was observed in the Hawaiian Islands by Mr. E. W. Broadbent, who found a green and yellow ribbon cane springing from the White Tanna. In this case the sport was quite distinct from the Striped Tanna, the parent of the White Tanna.

The Cavangerie cane, one of the standard varieties of the world, is extensively cultivated in Mauritius under the name Port Mackay. It is claret colored, with an inconspicuous but clearly defined deep green stripe. In Mauritius this variety has given rise to a black cane called the Port Mackay Noir.

Among the canes introduced into Mauritius from New Caledonia was a striped one originally known as Tsimbec, which is striped red and yellow. From it several sports have arisen, one of which, yellowish-red in color, is known as Iscambine Rouge and is grown on the plantation scale.

In Hawaii a variety called the Striped Tip (dark red and pinkish-green color),

of uncertain origin, has given rise to the Yellow Tip (light green becoming yellow at maturity).

SUMMARY

These scattering instances of bud variations may be briefly summarized as follows:

Bud variations in the sugar cane are quite common and have been recorded in Louisiana, the West Indies, Mauritius, Hawaii and Australia.

The difference between mother plants and sports is often as great as between recognized varieties.

Bud varieties have been noticed as—

1. Differently colored side shoots from one cane.
2. Differently colored canes in one stool growing from a single piece of planted cane.
3. A stalk with some joints striped and some unstriped.
4. Strains showing differences in hardiness.
5. Strains showing differences in sugar content.

Plants grown from cuttings of the bud sports tend to reproduce true to the character of the sports.

Better Dairying by Bull Associations—Joint Use of Good Sires Improves Herds[1]

Dairymen who would like to use pure-bred bulls to improve their herds but who cannot afford to purchase such animals should investigate the advantages of a coöperative bull association.

These organizations are formed by farmers for the joint ownership, use, and exchange of pure-bred bulls. The purchase price and cost of maintenance are distributed according to the number of cows owned by each member, thereby giving the dairyman an opportunity to build up his herd at a minimum expense. The organization also helps its members to market dairy stock and dairy products, to fight contagious diseases of cattle intelligently, and in other ways to assist in improving the dairy industry. Farmers' Bulletin 993, recently issued by the United States Department of Agriculture, gives directions for the organization and operation of bull organizations, together with constitution and by-laws necessary for such an organization.

The typical coöperative bull association, as recommended by the dairy specialists of the department, is composed of from fifteen to thirty farmers who jointly own five bulls. The territory in which these farmers live is divided into five "breeding blocks," one bull being assigned to each block.

In a survey conducted by the department on 1,219 farms in eight districts in Iowa, Minnesota, and Massachusetts, in which there were no associations, it was found that there were 817 bulls, having an average value of $76. Had the owners of these cheap bulls been properly organized, the same investment would have purchased the necessary bulls of an average value of $283. In one association having more than 100 members the original cost of good pure-bred bulls to each member was only $23. When questioned regarding the value of coöperative bull associations, 150 farmers in Maryland, Michigan and Minnesota estimated that the use of bulls belonging to the organization increased the value of the offspring in the first generation from 30% to 80%, with an average of 65%.

SUCCESS DEMANDS CARE

The selection of the bulls for an association is one of the most important considerations. A good pure-bred bull will make rapid and marked improvement in the herds, and the association interest increases in proportion to the improvement obtained. If a poor dairy bull is used, the milk production of the members' herds is sometimes reduced, the interest is lessened, and these conditions may lead to the breaking up of the association.

[1] Weekly News Letter, U. S. Department of Agriculture.

NEW PILLAR ROSE

W. Van Fleet

A MOST promising new hardy pillar or low-climbing rose of composite parentage, a result of applying pollen of a vigorous hybrid between the new Chinese *Rosa Soulieana* and *R. setigera,* the wild Michigan or Prairie rose, to the stigmas of an unusually hardy seedling of *R. Wichuraiana* that had the Tea rose Devoniensis as its pollen parent. All other seedlings of this crossing have a tinge of pink imparted by *R. setigera,* but the blooms of *W. S. 18* are pure white, relieved by the prominent yellow stamens that characterize three of the four species involved in its production. The flowers are borne in graceful clusters covering the whole plant, as shown in the illustration, and are succeeded by an equal number of good-sized deep red fruits that endure with little change in coloring all winter. The blooms are over 2 inches across, of perfect form and great substance, remaining in good condition for several days and are so thickly set that the petals nearly touch over the whole surface of the foliage, which is thick, firm and of a pleasing bluish-green shade. The canes are strong, arching, with heavy side-shoots bearing the great flower clusters, and are naturally so well arranged that little support or pruning appears to be needed. The plant proved entirely hardy during the past test winter that killed many supposedly hardy roses to the snow line.

The season of bloom at Washington is early June, and there is considerable fragrance of the character usually associated with the musk rose, to which *Rosa Soulieana* belongs. *W. S. 18* has not yet reached its full development and will probably grow 10 or more feet higher in favorable situations, and doubtless will find its greatest utility as a specimen tall bush or pillar rose, in open situations rather than as a porch climber. It is hardy and vigorous and appears resistant to all foliage and cane diseases that affect roses in this climate.

Rosa Soulieana was discovered about 1895 by the French explorer Pere Soulie growing in fair abundance along the upper reaches of the Yalung River in Southwest China and was soon after established in England, where it is regarded as perfectly hardy and grows in the open perhaps more vigorously than any other rose species. It was brought to this country in 1909 by the Office of Foreign Seed and Plant Introduction, and has turned out to be only doubtfully hardy about Washington, but otherwise well worth growing as an oriental wild rose. It is very floriferous when not too severely injured by winter, the creamy-white flowers, an inch or more across, being disposed in dense terminal corymbs, while the buds are pale yellow just before expanding. The strong canes grow 7 or 8 feet high in a season, and the abundant bluish-green foliage appears rarely troubled by insects or disease. The tendency to kill back in winter, however, has made it desirable to interbreed this interesting newcomer with other rose species and varieties of undoubted hardiness, and *W. S. 18* is at this time the most promising outcome, though many attractive seedlings, some of dwarf growth with double blush and white blooms borne throughout the growing season, have been secured. *Rosa Soulieana,* blended with desirable hardy rose species and varieties, appears likely to prove a valuable acquisition to the equipment of the breeder of garden roses.

In *W. S. 18, Rosa setigera* appears only to have contributed hardiness, *R. Soulieana* habit, foliage and abundance of bloom, while *R. Wichuraiana* and Devoniensis (*R. odorata*) size, substance and finish of the individual flowers.

[1] *Rosa Soulieana* × *W. S. 18,* Raised Bell Experiment Plot, Glendale, Maryland, 1915.

ROSE SEEDLING W. S. 18

Rosa soulieana x *R. setigera* ♁ × *R. wichuraiana* x *R. odorata* ♂. Blooming twig about two-thirds natural size. Photographed by Dr. W. Van Fleet at Bell, Md., June 12, 1918. (Fig. 18.)

ROSE SEEDLING W. S. 18

Rosa soulieana x *R. setigera* ♁ × *R. wichuraiana* x *R. odorata* ♂. Raised at Bell, Md. Plant three years from seed. Photographed by Dr. W. Van Fleet at Bell, Maryland, June 12, 1918. (Fig. 19.)

Pure-Bred Pigs "Preferred Stock"

More than 80,000 boys and girls in the United States are enrolled in pig clubs organized and conducted by the United States Department of Agriculture and the state agricultural colleges, and 71% of the reporting members raise pure-bred pigs. The juvenile wisdom displayed is supported by records showing that more than 12,000 pigs made an average daily gain of 1.14 pounds in weight, which is considerably above results obtained on most farms. Pig clubs, now established in twenty-eight states, are believed to have such a beneficial effect on the swine industry of the country that the Department of Agriculture has assigned forty-nine specialists to foster their further development.—*Weekly News Letter, U. S. Dept. of Agriculture.*

BIOLOGY AND POLITICS

Walter Sonneberg

THE danger in applying knowledge gained in one department of life to other and quite distinct departments lies in the tendency to ignore limitations of application. If we are going to apply principles formulated for biology to political conditions we want to be pretty sure in advance just what the limitations of those principles are. Alleyne Ireland[1] suggests the enforcement of a biological teaching to combat the growing worship of the "blind god of Numbers." Granting the impendment of catastrophe in the commitment of political power to the hands of proletariat, Germany's experience of biological principle does not furnish much encouragement for further application. It is now apparent that a biologically buttressed formula was the most potent inciter to Hun frightfulness.

Through the persuasion of Haeckel and his mechanistic logic, the doctrine "might makes right" was consolidated and confirmed in the German mind: through the idealization of man the machine Germany went down to civilization-crushing defeat—imagine the moral effect, on receptive minds, of the preachment that all life rose exclusively and strictly from mechanic stresses and chemical reactions. Earlier philosophers emphasized the advantages of a God relegated to the remoteness of ultra-astronomical confines; subsequent developments made manifest that the spiritual beauty they painted was a mirage veiling lust released and rapacity revivified. Discontented minds the world over eagerly devoured the alluring doctrine. What could be more palatable to their half enlightened mentality than a philosophy made up of egotism and irresponsibility compounded in a spiritual vacuum?

Mr. Ireland mentions the tendency of talent to concentrate hereditarily through selective mating; the advertisement and acceptance of this tendency is the only hope for rescuing the political hierarchy from the maw of Bolsheviki. Though we may be loath to admit it, the smoothness of our government operation is the outcome of the political wisdom of the self-selected few who control electorate votes. Where political power happens to foregather in fairly wise hands results are fairly satisfactory; where it is unwisely used democracy is less triumphant.

One thing is certain, neither biological nor political science has anything to gain by adherence to a scientifically repudiated mechanistic doctrine. Biologically it has served its purpose in stimulating research; politically it has proven criminally defective. In the hands of ignorance it undeniably furthers irresponsibility and immorality, notwithstanding naive protests of closest biologists.

As Dr. Frederick Adams Woods indicates,[2] it may be possible to eliminate despotic rulers by regulating the sources from which they spring, but a proletariat gone rabid, of misinformation and impracticable ideals cannot be disposed of so summarily. No satisfactorily permanent substitute for common sense has yet been found. Biology is under the strongest obligation to unteach what it has already taught, and leave politics to work out its own salvation. While agreeing with Mr. Ireland as to the unfitness of majority to vote intelligently on complicated political measures it is less easy to accept his remedy.

The glaring disparity between moral profession and performance in the modern world is its great defect. The remedy lies, not in formal education, not in biological formula; but in the steady and consistent example of work and sacrifice set by the knowing few for the unknowing many. Convert the energy of laudation and oratory into useful, character producing work. Nothing less will avail to stay the forces of license and licentiousness let loose by a mistaken application of biological doctrine.

[1] Journal of Heredity, December, 1918, p. 339.

[2] Journal of Heredity, December, 1918, p. 353.

MOTHER, TWO GRANDMOTHERS, AND FOUR GREAT-GRANDMOTHERS

Josephine Preston, of Denver, Colorado, three months old (when the photograph was taken), has the rare distinction of possessing two grandmothers and four great-grandmothers, all living. (Fig. 20.)

THE INCREASE, DIFFUSION, AND DECLINE OF THE MAYFLOWER AND OTHER NEW ENGLAND STOCK

Present Number of Living Mayflower Descendants Estimated at 85,000.

J. Gardner Bartlett
New England Historic Genealogical Society
Boston, Mass.

THE article in last November's number of this magazine by S. J. Holmes and C. M. Doud entitled "The Approaching Extinction of the Mayflower Descendants" has aroused wide interest. While the falling birth rate during the last seventy-five years among the New England stock has been deplorable, the present conditions are not quite so desperate as pictured by Messrs. Holmes and Doud, as their conclusions were based on far too small a field of data.

The early history of New England, the genealogies of its families, the increase and diffusion of the stock throughout the whole country, the decline in its birth rate during the last two generations, and the amount and effect of foreign immigration since 1845 have been subjects of much interest to the writer for twenty years.

About 25,000 English colonists settled New England between 1620 and 1643 (over 20,000 coming between 1630 and 1640), after which general immigration ceased until after 1790, except for about 8,000 Scotch-Irish immigrants who came here between 1715 and 1750. The total population of New England in 1650 was about 33,000. Colonial censuses and study of vital records in thousands of families in New England genealogies establish that this old stock doubled in population about every 28 years, which give the following data on

Population of New England Stock

1650	33,000
1678	66,000
1706	132,000
1734	275,000
1762	560,000
1790	1,125,000

(The Scotch-Irish immigration, 1715–1750, is the cause of a little more than doubling in the figures of 1734 and 1762.)

According to the United States Census of 1790, the population of New England was 1,009,000; but at that time at least 115,000 persons of New England origin were living outside New England, mainly in New York, New Jersey and Pennsylvania. So of the nearly 4,000,000 total population of the United States in 1790, about 1,125,000, or about 28%, were of the old New England stock, which continued to double about every twenty-eight years until about 1845. Its birth rate then commenced to fall, so about forty years elapsed before the population of this stock had again doubled about 1885; and since then a further fall in birth rate has resulted in thirty-four years in an increase of hardly 25% in this stock in 1919 over what it was in 1885.

United States Censuses, immigration statistics, and the preceding figures on New England stock, show how the latter has steadily decreased in its percentage in the total population of the country since 1790.

Year	*Total Pop.*	*N. E. Stock*	*P. C.*
1790......	4,000,000	1,125,000	28
1818......	9,000,000	2,250,000	25
1845......	20,000,000	4,500,000	22½
1885......	55,000,000	9,000,000	16
1919......	106,000,000	11,000,000	10½

Immigration to the United States

1790–1818 (estimated).......	250,000[1]
1818–1845..................	1,000,000
1845–1885..................	11,000,000
1885–1919..................	21,000,000

From 1650 to 1845 when the New England stock doubled by reproduction about every twenty-eight years, the vital records of over 10,000 separate families taken from 100 genealogies of New England families show an average of nearly eight children per marriage, of whom an average of nearly two died in infancy or unmarried, the infant mortality being rather high.

An examination of 9,000 completed families in twenty genealogies of New England stock where the parents married between 1880 and 1910 shows an average of 2.92 children per family. About 6,000 of these marriages between 1880 and 1900 had an average 3.15 children; and about 3,000 marriages between 1900 and 1910 had an average of 2.71 children. These 9,000 families were not picked or selected, but embraced all degrees, wealthy and poor, cultured and uncultured, of many kinds of occupations or professions, and with residences on farms, in small towns and in great cities located all over the United States. This wider scope of data results in much higher figures of fertility than Messrs. Holmes and Doud secured from their note of only seventy-three marriages since 1880 which gave but 2.04 children per marriage; and their data of only 1.5 children per marriage from their twenty marriages since 1900, is certainly far too low for a general average of the whole stock throughout the country, which doubtless still continues at over 2.5 children per marriage.

According to my observation and compilations, the United States is not as ready a melting-pot of races as popularly supposed. The old New England stock, now spread all over the country, still continues remarkably pure, as its members still marry principally among themselves, and if not, then generally with British stock of English, Scotch, Scotch-Irish, or Welsh descent, or with the descendants of the old New York Dutch; marriages with persons of Irish, German, Slavic, or Latin descent are infrequent.

The "Mayflower Descendants" have naturally experienced increase, diffusion and recent decline in fertility similar to that of the rest of the New England stock. By exceptional temporary fertility, the 101 passengers of the "Mayflower," although fifty died within a few months, increased from 1620 to 1650 to at least 270 souls living in the latter year who can be named. Using the previously quoted proportions of increase, the following results appear:

Year	*Living Mayflower descendants*
1650......................	270
1678......................	540
1706......................	1,080
1734......................	2,160
1762......................	4,320
1790......................	8,640
1818......................	17,280
1845......................	34,560
1885......................	69,120
1919......................	85,000

An average birth rate as low as 2.50 children per family can doubtless sustain the Mayflower stock to its present strength of 85,000; so the apparent present rate of about 2.71 is encouraging against its "extinction." The same birth rate of 2.50 will also maintain at its present numbers the 11,000,000 of the rest of the old New England stock, now spread all over the country although its percentage in the total population will decrease below the present 10.5 per cent, owing to past and future immigration of foreigners of higher fecundity.

[1] The 80,000 population acquired by the Louisiana Purchase in 1803 is included in this estimate.

VARIATION, SELECTION AND MUTATION IN ONE OF THE PROTOZOA

THERE is a theory that the one-celled organisms dividing as they do by simple fission ought to be all alike in their heredity substances, in other words that the genotype should be constant, and selection should be of no avail. The recent work of Middleton and Jennings has brought this theory into question and still more recently (1918) R. W. Hegner has made a contribution to this fundamental biological problem. In his investigation Professor Hegner used one of the lowest and simplest of animals but one that fortunately has a variable characteristic that readily lends itself to accurate observation, namely the number of spines on its shell. His conclusions and proofs are clearly given in Volume 4 of the Proceedings of the National Academy of Sciences. In summarized form they are as follows:

Arcella dentata is a microscopic protozoon belonging to the lowest class, the Rhizopoda. It is as simple as any animal organism it is possible to obtain that has measurable characteristics. It varies in diameter from 73 microns to 150 microns and in spine number from 7 to 20. It multiplies vegetatively and rapidly and the characteristics of the shell are not modified by growth or by the environment, and are heritable but variable. Can heritably diverse lines with respect to spine number and diameter of shell be distinguished among the descendants of a simgle specimen of *Arcella dentata* produced by simple fission?

Small families were reared from 70 "wild" specimens selected so as to include large, small, and medium sized organisms. Seven hundred and forty-six specimens were obtained in this way, ranging in number from only 2 or 3 to 149 per family. The mean spine number of the families ranged from 10.40 to 14.07. Variations in spine number occurred among the descendants of single specimens during fission and these variations were in part inherited. It was found that the hereditary constitution of the different families was different with respect to spine number and the conclusion was reached that a "wild" population consists of a large number of heritably diverse families so far as spine number is concerned, and also probably as regards diameter, since spine number and diameter are closely correlated.

The main problem was next undertaken, *i. e.*, an attempt was made to isolate heritably diverse lines from among the descendants of a single specimen produced by vegetative reproduction.

The data prove that the descendants of a single specimen of *Arcella dentata* produced by vegetative reproduction differ slightly from one another in their hereditary constitution and that heritably diverse lines may be isolated from among them, differing both in spine number and in diameter, and that these two characters are closely correlated. These heritably diverse lines resemble certain of the families that were reared from "wild" specimens, and suggest that differences in the hereditary constitution of these wild specimens may have originated in the same way.

The general conclusion reached is that within a large family of *Arcella dentata* produced by vegetative reproduction from a single specimen, there are many heritably diverse branches. These diversities are due both to very slight variations and to sudden large variations ("mutations"). The formation of such hereditarily diverse branches appears to be a true case of evolution that has been observed in the laboratory and that occurs in a similar way in nature.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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KOELREUTER, THE FIRST SCIENTIFIC PLANT BREEDER

In 1760 Koelreuter produced the first plant hybrid ever obtained in a scientific experiment.
(Frontispiece.)

THE FOUNDERS OF THE ART OF BREEDING—II

Work of the Earlier Hybridists—Other Great Discoverers Long Neglected, as Was the Case with Mendel

Herbert F. Roberts
Kansas State Agricultural College

IN A previous article,[1] the writer described the early work in plant breeding, which came about through the accidental contact of the people of Mesopotamia with the date palm, the discovery thereby of the fact of sex in plants, which underlies breeding, and Camerarius' scientific investigations upon plant sex. The present article deals with the work of some of the earlier hybridists, whose experiments determined the course of the art of plant breeding before Mendel's time.

KOELREUTER, THE FIRST SCIENTIFIC PLANT BREEDER

Camerarius' now famous Latin letter fell on sterile, or rather on unprepared soil. Over half a century had to pass by before one was found to speak his praise. "Rudolf Jacob Camerer is indisputably the first who proved the sex of plants through his own experiments, instituted with this idea in view. . . In this manuscript (the letter to Valentin), which far surpasses in thoroughness, completeness and good execution, almost all the writings of this nature which have thus far come to light up to the present day, he appeared to have at once exhausted everything which might have been said on the subject up to his time." These were the words of Joseph Gottlieb Koelreuter: From the 25th of August, 1694, when Camerarius wrote his letter concerning his experiments upon sex in plants, until September 1, 1761, there had been no real progress in the scientific knowledge which underlies plant breeding. On this latter date, however, appeared Koelreuter's "Preliminary Report of some Experiments and Observations concerning Sex in Plants"(4). This report, followed in 1763, 1764, and 1766, by three additional papers on the same subject, record the results of 136 distinct experiments in the crossing of plants.

If Camerarius made the actual scientific discovery of sex in plants, Koelreuter was the first to apply this discovery to their scientific breeding. Koelreuter was born April 27, 1733, in the Swabian village of Sulz, in the valley of the Neckar, in the Black Forest region of southwest Germany. He conducted his experiments partly in his native village, partly in the garden of a physician in the town of Calw in Württemberg, and partly in St. Petersburg, Berlin, and Leipzig. From 1764, until his death in 1806, he was Professor of Natural History in the University of Karlsruhe. At Sulz, in 1760, Koelreuter produced the first plant hybrid ever obtained in a scientific experiment.

THE FIRST "MULE" PLANT

In Koelreuter's quaint German, we read of the reasons which led him to experiment upon the breeding of plants. He calls attention to the fact that man has brought together into botanical and zoölogical gardens, plants and animals from all quarters of the earth. With animals, this has given rise to the possibility of making hybrids. "Would a goldfinch ever have mated with a

[1]Journal of Heredity, vol. x, p. 99.

canary bird, and have produced hybrid offspring," he naïvely comments, "if man had not furnished them the opportunity to come to know each other more intimately?" He then goes on to remark upon the possibility of plant hybrids having been similarly produced in botanic gardens, between related plants, which had thus been brought into accidental proximity to one another and says:

"Because I was long since convinced of the sexuality of plants, and had never doubted the possibility of such an unnatural procreation, I, therefore, let myself be deterred by nothing from instituting experiments on the subject, in the good hope that I might perhaps be so fortunate as to bring into existence a hybrid plant. After many experiments carried on in vain with several kinds of plants, in the past year, 1760, I got so far in the case of two different species of a natural group, *Nicotiana paniculata* and *Nicotiana rustica*, that I fertilized with the seminal dust (pollen) of the former, the ovaries of the latter, obtained perfect seeds, and from these, in the very same year, have raised young plants."

Some twenty of these hybrids came to maturity, and were found to occupy an almost exactly intermediate position between the two parents, with respect to all of their characters examined. Unfortunately, these hybrids were completely sterile, and Koelreuter adds this odd remark: "This plant is thus in a real sense, an actual, and so far as is known to me, the first botanical mule which has been produced by art."

Koelreuter made, besides other crosses between species of Nicotiana, crosses between species of Kedmia, pink (*Dianthus*), stocks (*Matthiola*), dogbane (*Hyoscyamus*) and burdock (*Verbascum*). He ascertained the fact, that in general only nearly related plants, and not always even these, can be crossed. He determined experimentally the fact that if the stigmas of flowers are pollinated at the same time by their own and by pollen from another species, that fertilization is effected by the former, which would account for the comparative rarity of "species hybrids" in nature. Koelreuter also made the very important discovery, the explanation of which was not furnished until much later, that the continued self-pollination of hybrids finally results in the re-appearance of the original parental forms.

His ideas regarding fertilization are interesting. He thought that a plant was formed by the fusion of two fluid materials of different sorts. The prepotence of the one parent over the other, where it occurred, was ascribed to the fact that, "since these materials are of different sort, or in their essence are different from each other, it is easy to comprehend that the strength of one must be different from the strength of the other."

MISCELLANEOUS EXPERIMENTS REGARDING SEX IN PLANTS

Camerarius and Koelreuter stand as the two great landmarks in the history of scientific plant breeding up to 1766. While these two were the only investigators whose contributions to our knowledge of sex in plants were extensive or fundamental, it is of interest to know that the first person who is reported to have actually crossed plants artificially, was an Englishman named Thomas Fairchild, who, according to Bradley (1, p. 16), crossed two kinds of pinks in 1719. The cross in question was known still to gardens, one hundred years later, as "Fairchild's Sweet William," nevertheless, as Focke says (p. 430): "This success in artificial fertilization was never utilized for science, nor does it appear to have given gardeners any stimulus to further investigations."

Two years earlier than this, Bradley himself (1, p. 20) had removed the anthers from the flowers of twelve tulips which he had planted in a remote place in his garden, and had found that they produced no seeds, while some four hundred tulips planted elsewhere in the garden and left intact, produced seeds freely.

Twenty years later, in 1739, James Logan, an American citizen of Irish birth, and at that time governor of

Pennsylvania, published in Latin (5), an account of his experiments with Indian corn, or maize. In each of the four corners of a plot of ground forty by eighty feet in size, he planted Indian corn. The plants in one corner, being detasseled, produced no seeds. From certain ears, he removed part of the silks, and found that only those grains to which the silks were left attached, became fertilized, and grew to maturity. He also wrapped one ear in cloth before the silks appeared, with the result that no seeds whatever were produced.

"In 1731, Philip Miller, in the first edition of his "Gardeners' Dictionary" (6) reported his own repetition of Bradley's experiment with tulips, as follows:

"I set twelve tulips by themselves, about six or seven yards from any other, and as soon as they blew, I took out the stamina with their summits so very carefully that I scattered none of the male dust; and about two days afterwards I saw bees working on a bed of tulips, where I did not take out the stamina; and when they came out, they were loaded with the Farina or male dust on their bodies and legs; and I saw them fly into the tulips, where I had taken out the stamina, and when they came out, I found they had left behind them sufficient to impregnate these flowers, for they bore good ripe seeds which afterward grew."

Miller also grew male and female plants of spinach apart, and found that the latter bore seeds which contained no embryos.

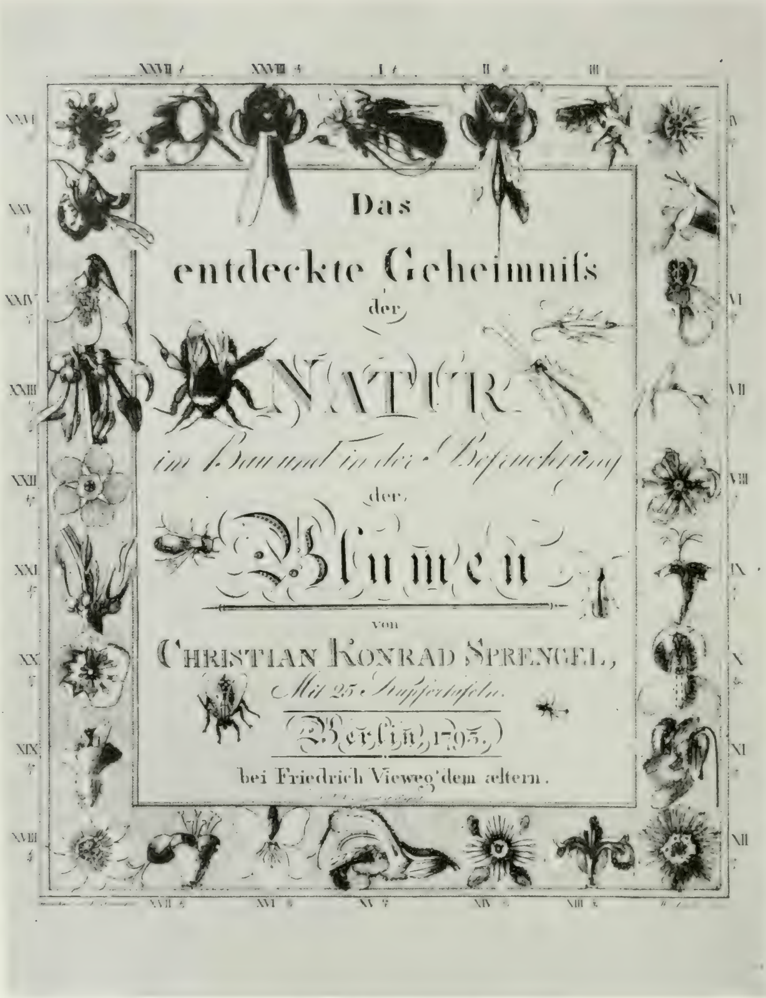
In 1751, Gleditsch, Director of the Berlin Botanical Garden, published an account (3) of an experiment in crossing a species of palm (*Chamaerops humilis*), of which Sachs says in his History of Botany, "This treatise, in point of its scientific tone and learned handling of the question, is the best that appeared between the time of Camerarius and that of Koelreuter."

Gleditsch had a pistillate palm in the botanical garden in Berlin, which, although some eighty years old, had never borne fruit. There was a male tree of the same species in a garden in Leipzig. In the spring of 1749 he obtained from this tree a quantity of pollen, which arrived in Berlin nine days later, a journey which today requires two and one-quarter hours. In consequence of the long journey, most of the pollen had fallen out of the withered staminate flowers. Nevertheless he pollinated the female flowers with the loose pollen, and was rewarded by seeing fruit ripen and produce seeds, which germinated in the spring of 1750.

This sketches briefly all of the important experiments known to have been performed in connection with the investigation of sex in plants, between the days of Camerarius and Koelreuter. By the middle of the eighth century, therefore, little doubt should have remained in scientific minds regarding the existence of sex in plants, or as to the necessity of the pollen as a fertilizing agent. Moreover, actual experiments in fertilization, many of them between plants of different species, had been successfully carried out in more than twenty important groups of plants, from many different families. We have also, in Koelreuter's work, a careful study of the characteristics of hybrids, obtained in sixty-five different hybridization experiments, conducted with species from a dozen different genera, belonging to diverse families, together with an accurate comparison of the characters of the hybrid plants of the first generation with those of their parents.

A scientific foundation was therefore laid at last for the breeding of plants. The value of Koelreuter's experimental work was doubted, however, by influential contemporary critics, although Sagerer (7), whose opinion should have carried weight, said of Koelreuter: "Having several times repeated his experiments I have had occasion to convince myself more and more of his exactitude and of his veracity; I believe then that he merits all confidence." It was the fate, therefore, of Koelreuter as of Camerarius, to remain practically unknown and unheeded by his own generation, and to exert no influence whatever upon the theory and practice of his day.

Despite, however, the fact that Koelreuter had demonstrated the possibility



TITLE PAGE OF A GREAT CLASSIC

Title page of the first edition of "Sprengel's Secret of Nature," in which he reveals his discovery of insect fertilization. (Fig. 1.)

of crossing plants artificially, and had even laid the foundations for a knowledge of the laws governing hybrids, much doubt still remained in the minds of botanists, regarding the facts which Camerarius' and Koelreuter's experiments demonstrated. As Sachs remarks. "The plant collectors of the Linnaean school, as well as the true systematists at the end of the eighteenth century, had little understanding for such labors as Koelreuter's."

Gärtner says, writing in 1849 (2, p. 5): "Hybridization in its scientific significance was so little thought of, and, at the most, regarded merely as a proof of the sexuality of plants, that the many important suggestions and actual data which this diligent and exact observer recorded in various treatises have found but little acceptance in plant physiological papers up to the most recent times. On the other hand, even in respect to the sexuality of plants, they were attacked to such a degree, that their genuineness was doubted and strenuously contradicted, or else they were regarded as a sort of inoculation phenomenon belonging to gardening." Such is the usual history of scientific progress.

THE REVELATIONS OF SPRENGEL

While Camerarius had demonstrated the fact that plants possess sex, and Koelreuter had shown that fertile hybrids could be produced between plants of different kinds, the further fact that crossing in nature, at least among different individuals of the same species, is a common and ordinary phenomenon in the plant kingdom, was not at all known. Aware, as we are today, that the improvement of cultivated plants, due to the appearance of new strains and varieties, is to be accredited largely to the natural crossing of individuals standing in fairly close relationship to one another, we can see the importance to plant breeding, of the next great discovery, that flowers are commonly pollinated by insects, and that there is an intimate inter-relationship between the plant and the insect world.

Christian Konrad Sprengel (1750–1816), published in 1793 (8), an epoch-making book, "The Newly Revealed Secret of Nature in the Structure and Fertilization of Flowers," which constitutes the third great landmark in plant breeding, after the original discovery of plant sex by the Asiatic date breeders in the unknown past. It was Sprengel's chief contribution, to discover the fact of insect fertilization. Such a wealth of accurate, first-hand observations on the adaptations of flowers to cross pollinations, had never before been made. To Sprengel also is due the discovery of dichogamy, *i. e.*, the maturing of the stamens and pistils of flowers at different times. His conclusion, that nature in most cases, intended that flowers should not be fertilized by their own pollen, and that the peculiarities of flower structure can only be understood, when studied in relation to the insect world, was revolutionary for his time. "Here was the first attempt to explain the origin of organic forms from definite relations to their environment."

THE SIGNIFICANCE OF SPRENGEL'S DISCOVERY TO PLANT BREEDING

Conceding the fact that plants actually have sex, it is plain that some kind of breeding must be possible. Granting that hybrids, even between different species, can be produced, it is further plain that new kinds of plants can be originated. But what of the additional fact—the contribution of Sprengel—that in general, nearly all flowering plants with definite floral envelopes are naturally cross-fertilized. It means simply this, that the bringing together of new combinations of parental characters is the rule rather than the exception in nature, and that, therefore, the breeding of new types in the plant world may be said to be going on all of the time. It remained for Darwin to show how the results from such perpetual crossings are limited and held in check by the operation of natural selection. At all events, Sprengel's discoveries at once disclosed at least an important reason for the diversity—the existence of so many variations in nature, upon

which fact man had depended for the selection of "superior" types of plants, and hence for the "improvement" of plant races.

But, unfortunately, these discoveries and disclosures of Sprengel's awakened little interest at the time. Like Camerarius and Koelreuter, Sprengel, in turn, was a stone that the builders rejected. Biologists of his day believed in the dogma of the fixity of species, to which Koelreuter's experiments in the making of hybrids, and Sprengel's epoch-making discoveries regarding cross-pollination by means of insects, were directly contradictory.

THE OPENING OF A NEW ERA

The beginning of the nineteenth century marks the beginning of a new era in plant breeding, initiated by the work of the English breeders and naturalists, Andrew Knight and William Herbert, and of the celebrated German hybridizer, Carl Friedrich von Gärtner. Through the extensive and intelligent experimentation of these men, the fact of sexuality in plants was emphasized, and the inauguration of the era of practical plant breeding was effected. Although the scientific world of today traces a continuity of thought and investigation from Gärtner back to Camerarius, the fact must not be lost sight of, that each of the three great investigators who laid the foundations of plant breeding—Camerarius, Koelreuter, and Sprengel—was completely ignored by, and practically unknown to, the biological science of his own time. The torch of discovery was not passed from hand to hand, but was lighted, as it were, three separate times.

Two human generations elapsed from the work of Camerarius to that of Koelreuter, and one generation from Koelreuter to Sprengel. It is more than another generation from Sprengel's publication to the time of the best work of Herbert (1837). It is a third of a generation more to the appearance of Gärtner's memoir (1849), and about half of another generation more to the appearance of Mendel's epoch-making and now celebrated papers (1866), and more than another generation again to the date of the final rediscovery of Mendel's work (1900), the beginning of the Mendelian or scientific age of plant breeding, which ushered in the era of the development of what we call the science of "genetics."

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A UNIFOLIOLATE MUTATION IN THE ADZUKI BEAN

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THE Adzuki Bean (*Phaseolus angularis*), like other members of the genus Phaseolus to which our common beans belong, is trifoliate. Although the first pair of leaves above the cotyledons are simple, those later formed are regularly compound each with three leaflets. Occasional abnormalities in individual leaves, it is true, may be found, and the writer has record of a seedling plant with but a single simple leaf which was unable to continue growth on account of the lack of buds. So far as the writer is aware, however, a full-grown Adzuki Bean plant with all its leaves simple has only once been observed. In view of the number of plants of this species that have been under close observation for a considerable length of time, it seems worth while to make a brief record of this occurrence.

The plant on the right in Fig. 2 is shown beside a normal individual from the same pedigree. Unfortunately the photograph was not taken till late in the season when the foliage was in an imperfect condition. A typical unifoliolate leaf isolated from this plant is shown on the background at the right in contrast with a typical trifoliate leaf on the extreme left from the normal plant. The mutant plant was somewhat taller than its neighbors in the same pedigree, was more branched and retained its leaves longer. In fact it was difficult when the photograph was taken to find a normal plant that had not lost most of its leaves. These peculiarities in habit may be due to the fact that the plant was entirely sterile, and vegetative functions in consequence were not checked by the production of fruit. Buds were formed in densely packed spikes giving promise of abundant flowers. No fully formed flowers, however, ever developed. The buds all dropped at an early stage before the petals were visible. As the dropping proceeded from the base upwards, the axis of the cluster progressively elongated and thickened. These floral clusters may be seen projecting from the plant in many places. They show the terminal clusters of young buds and the elongated axes studded with warty scars that mark the places from which buds have fallen.

The unifoliate plant was the only one of its kind in a row of some 1,500 plants grown in 1918. The parents of this pedigree were the offspring of a single select plant grown in 1918. The line from which the mutant arose came from a single plant grown in 1913. The descendants of this original plant, including a number of sublines, comprise 2,672 individually counted plants in addition to about 4,700 plants not actually counted although grown under close inspection. It is safe to say, therefore, that the mutant in question was the only one of its kind in an inbred line comprising around 7,400 individuals. Moreover, no unifoliolate plant has been observed in rather extensive plantings of Adzuki Beans of various other lines. In 1917 all the plants in the field, numbering 42,174 individuals, were under close observation and frequent records were taken of them in regard to time of flowering and maturity of pods. In 1918, select pedigrees comprising around 74,100 individuals were likewise repeatedly inspected for flowering and maturity. All the plants grown in the field in 1917 and the select pedigrees of 1918 were so frequently inspected that it

UNIFOLIOLATE MUTATION IN THE ADZUKI BEAN

The Adzuki, like most common beans, is trifoliolate as shown in the smaller plant at the left. A typical unifoliolate leaf isolated from the mutant is shown on the background at the right in contrast to a typical trifoliolate leaf on the extreme left. This mutation may be in the nature of a reversion. (Fig. 2.)

seems improbable that such a striking variation as the one photographed could have escaped notice. The same is true of 5,938 plants grown in the greenhouse. A total, then, of over 122,000 plants were grown under close observation without showing another mutant of this kind.

Since the simple-leaved form is sterile and moreover retains its leaves in the fall after other plants have become defoliated, it is a conspicuous object at time of harvest. If such a plant had been present in the 228,000 and more individuals grown in multiplication pedigrees in 1918, it would have stood good chance of being discovered at harvest, although these multiplication pedigrees were not so often nor so closely inspected during the growing season. It is not entirely improbable, therefore, that the mutant occurred only once among over 450,000 plants which were kept under more or less strict observation.

Numerous varieties of the Adzuki Bean have been introduced and grown in trial plats by the department of Forage Crop Investigation of the U. S. Bureau of Plant Industry during the last twenty years. Dr. C. V. Piper and Mr. W. J. Morse, who have had charge of the tests in this department, report that they have never seen a plant of the Aszuki Bean with unifoliolate leaves.

Another representative of the genus Phaseolus (*P. Vulgaris*) has been studied by Dr. J. Arthur Harris in reference to the occurrence of abnormalities in the seedlings. He has kindly informed the writer that only once has he found plants with unifoliolate leaves. Three individuals in a pedigree, the offspring from a single parent, had undivided leaves and were otherwise abnormal. Outside of this single pedigree, none of the several million plants of the pea bean individually examined for abnormalities was found with simple leaves.

The Legumenosae are predominately characterized by compound leaves. In a few genera, however, the leaves are simple. As familiar examples of the latter condition may be mentioned the Redbud (*Cercis*), the Rattlebox (*Crotolaria*) and the Dyer's Greenweed *Genista*). In Rhynchosia, typically a trifoliolate genus, one species (*R. simplex*) has only unifoliolate leaves. These facts may suggest that in the evolution of the Leguminosae the present predominately compound foliage has been derived from a simple-leaved condition. Such a supposition might be supported by the genus Bauhinia, which apparently shows various stages in the process of conversion of a simple to a compound leaf by progressive furrowing between lobes. The unifoliolate representatives of the family might, therefore, be considered arrested stages in evolution or reversions to an ancestral type. Under this interpretation, the mutation under discussion would be in the nature of a reversion. It must not be denied, however, that some may prefer to read the evolutionary trend in the reversed direction and to consider the mutation a progressive one.

All the facts presented show that the unifoliolate type here reported for the Adzuki Bean is an extremely rare variant. Despite the fact that its inheritance could not be established by breeding experiments, it has been called a mutation. Its failure to appear more than once in so large a number of individuals indicates that it is a variation genotypic in nature, since it could scarcely be attributed to the reappearance of a character through normal segregation nor be considered a mere modification induced by environmental factors.

BREEDING MILK GOATS

Anglo-Swiss and Egyptian Breeds Are Popular in the United States – The Industry a Profitable one—Distinctive American Breed Is Needed

J. W. THOMPSON

Ex-Editor "Spirit of the West," "Stock Farm," Etc.

IT IS obvious that a new source of milk supply is rapidly becoming a necessity in this country. Various causes are bringing it about. One is the speedy multiplication of densely inhabited cities and towns, with population so closely crowded as to preclude, largely, the keeping of the cumbersome and unsanitary family cow. Another is, failing lands, both in area and productiveness, with increased high cost of feed, of all sorts, for maintaining extensive dairies to supply milk at a price not prohibitive to average households. A third cause is the menace of tubercular affection in the bovine species, with other infections and impurities connected with dairying institutions, defying all efforts successfully to correct or remove them.

Casting about for a substitute, none other appears, on the whole, to present as many and strong claims to take the place as the genus Capra, the animal first employed by mankind to supply the earliest and most wholesome of all goods.

A MODERN IMPROVED TYPE

A vastly improved variety has been developed in recent years, manifesting capacity and possibility in milk production of very high order. The orient has led off in this, as in the first domestication of the animal, and is the source from which this country has to derive its foundation stock. Upper Egypt, Abyssinia and Nubia have developed what is known as the Nubian breed, which, modified by a cross with natives in England, has given the Anglo-Nubian largely in use in that country. Switzerland has evolved three distinct varieties, the Toggenburg, the Saanen and the Guggisberger, which, with the Maltese, found in the island of Malta, comprise practically all entitled to the claim of special adaptation. This country has lagged far behind in developing an industry productive of the kind, making the first importations worthy of mention less than a score of years ago, and on the menace of the "foot and mouth disease," putting a ban on the further import of all animals liable to prove carriers of the dreaded germs. A limited number of pure-bred descendants of those brought in, with the class of grades resulting from crosses made with the native stock, compose the total holdings up to the present, so scant that the limited number of enthusiastic breeders and owners are combining in an effort to induce the Government, under its own agency, to procure additional stock of each of the established breeds from the forbidden lands across the sea.

MILK-PRODUCING VALUE

The capability of the high-bred class to produce milk in quantity and quality encouraging a general introduction is sufficiently well established to convince the most sceptical, while even the better specimens of grades of relatively low order show up in an astonishing manner. A test made at the farm of the California Agricultural College, of a grade Toggenburg doe, showed a milk yield, in 365 consecutive days, of 2,914 pounds, and the conclusion of numerous experiments made by the same institution is, that average does of the sort can be largely bred, yielding 3 to 4 quarts per day for a lactic period of eight to ten months. The flavor of the

TWO PURE-BRED SAANEN DOES

This is one of the three varieties developed in Switzerland. The other two are the Toggenburg and Guggisberger. The does shown in this picture have milked more than 14 pounds per day each. Courtesy of *The Goat World*. (Fig. 3.)

milk is pronounced virtually identical with the best from the cow, indistinguishable in our experience, and in richness, on the average, superior, about equivalent to what is termed 'thin cream.' Its wholesomeness is, however, much more strongly insisted upon by numerous authorities, including physicians, chemical analysts and experts of various sorts. Particularly has its

PURE-BRED ANGLO-NUBIAN GOAT

This cross between the Nubian of Africa and the native English is largely in use in England. This doe has a record of more than 5 quarts daily for a long period. Courtesy of *The Goat World*. (Fig. 4.)

worth been proven in the case of delicate and failing infants, surpassing any known preparation as an artificial food for babes not nurtured at the mother's breast, and, likewise, for the aged, infirm and ailing, having almost a remedial virtue in many instances; while as an article for general use, in addition to its superiority in other food elements, its supreme excellence lies in the fact of the large preponderance it possesses, over other milks in use, in the life-giving property of vitamines.

FREEDOM FROM DISEASE GERMS

The long-reputed freedom of the hircine tribe, comparatively with all other domestic animals, from tubercular and other disease germs, appears to be well authenticated. From time immemorial the reputation of this mountain ruminant for general hardiness and healthfulness has been universally conceded, its very presence with other animals being popularly believed to have a preventive, if not curative effect, in the case of many ailments. Although not proven absolutely immune to the fatal malady of tuberculosis, yet the goat tribe, as a whole, has been found virtually proof against invasion by its fearful virus, even inoculation with it, in tests made, being effectually resisted.

PURE-BRED TOGGENBURG DOES

These, with the Guggisberger and Saanen (Fig. 3), form the standard Swiss breeds. America has not yet developed a distinctive breed. These five goats were giving 49 pounds of milk daily when the picture was taken. Courtesy of *The Goat World*. (Fig. 5.)

Climaxing the claims to be put forward in its favor is consideration of economy. First is the small space into which it may be cramped and the consequent cheap housing, covering all exactions in two particulars, so difficult to provide for in the instance of the more gross and untidy cow. The back yard, at command of most households, and a kennel such as is often provided for the children's pet dog, will suffice, while the unusual freedom from odor of the doe, with its exceptional cleanliness, fits it for close proximity to residences or other buildings, and its docility permits its use for the children's pet. Again, no other discovered domestic animal that could fill the place can be fed at as small an outlay. In quantity of feed, careful computations figure on one-eighth of what is required to maintain a cow in like condition. In actual cost, this amount may be indefinitely reduced in the vast majority of instances. Tethering out in summer on lawns, road sides, vacant lots, etc., will be found feasible, frequently sustaining entirely for an extended period. The weeds and waste from gardens, peelings and discarded vegetables, with scraps from the table, will furnish another large portion of acceptable provender. Then the class of feed to be purchased may be of the cheapest order of forage and mill products, articles which the goat relishes as no other domestic animal.

The sale of kids produced, and the meat and pelt value, which have been the chief revenues derived from handling the common goat, have not been mentioned—left entirely as "velvet."

A main obstacle to a wide ownership in this country, aside from shortness of

supply, is the price demanded, making a truly desirable doe, instead of the "poor man's cow," the "rich man's luxury."

Richly pedigreed, tested does command figures running well up into the hundreds, the record price having been set at the Liberty Fair in Los Angeles, California, the first days of the present year, in the sale of the Toggenburg, Princess Louise, No. 739 A.M.G.A., yielding $6\frac{1}{4}$ quarts of milk in twenty-four hours, and producing fourteen kids in her four kiddings, for $700. Fairly good producing grades sell for from $50 to $75, while top males bring from $200 to the record of $1,000. Lower grades, and young untried things, are vended all the way from $25 down to the price of market stock.

Such a state of affairs affords an attractive opportunity for progressive spirits to engage in the enterprise of breeding, handling and perfecting milk goats, up to the unlimited possibilities clearly attainable.

Hermaphrodite Bees

One of the beekeepers in this district has just been telling me of a further development of the unusual experience he had with one of his colonies in 1917. During that year, and again in 1918, large numbers of malformed bees were thrown out of one of his hives. On making an examination of these bees as many as thirteen distinct and curious combinations were observed. Some of them had a worker eye on the left side of the head and a drone eye on the other, and some just the reverse. Others were perfectly formed drones as far as the petiole (the tube connecting the thorax with the abdomen), the abdomens from that point being in every way the same as workers, including the sting. Others again were just the reverse of this. These monstrosities all emerged from worker cells which were capped in such a peculiar manner that they could all be recognized before hatching out. There was apparently nothing radically amiss with the queen otherwise as the colony built up rapidly in the spring and swarmed early in the season. At this time five nuclei were made from the hive and now comes the remarkable and strange part of the story. All these nuclei have repeated the same phenomena as the parent colony, similar types of malformed bees having been thrown out of every one. Here, therefore is direct evidence of a well defined, although undesirable, trait, or characteristic, in a queen being transmitted to her next succeeding generation. A theory advanced, when the occurrence was first observed in 1917, was that possibly the old queen might have been mated with a drone emanating from a laying worker.—W. J. SHEPPARD, NELSON, B. C., *in British Columbia Farmer.*

Families of the First-Born

Analyzing more than 20,000 individual histories in five American genealogies, Carl E. Jones (Quarterly Pubs., Am. Stat. Ass'n, December, 1918), finds that the first-born marry in the same proportion as other members of their families, and that when they marry they have on the average just as many children as do their sibs. He infers that, whatever the handicaps may be under which the first-born is alleged to labor, these handicaps are not of a character to interfere with his racial value. Mr. Jones extracts from his data a number of other conclusions, most of which are confirmatory of those secured by Alexander Graham Bell in his study of the Hyde family, parts of which have been presented in various issues of the JOURNAL OF HEREDITY.

HEREDITY AND DEMOCRACY

A Reply to Mr. Alleyne Ireland

Edwin G. Conklin

I

IN SEVERAL addresses given during the course of the war and in an article in *Scribner's Magazine* for April, 1919, I have attempted to show that the principles of heredity and evolution are not opposed to the essential principles of democracy. In the Journal of Heredity for December, 1918, Mr. Alleyne Ireland comes to a directly opposite conclusion. Mr. Ireland speaks out of an experience of more than twenty-five years as a student of government in a score of countries "with a dozen governmental systems ranging between the extremes of the autocratic and of the democratic forms." As a result of this experience he concludes "that the best governed countries were those in which the mass of the people had the least control over the administration of public affairs. By 'best governed' I mean best provided with internal peace, with justice, with honest and competent officials, with protection for life, property, with freedom of individual action, with arrangements for promoting the general welfare."

This is a conclusion of such a startling character that it may well challenge the attention of students of government throughout the world. The facts upon which it is based need to be presented in greater detail, and if it is confirmed by further study it behooves the defenders of democracy to show that the evils of democratic government are not necessary evils or that they are more than compensated for by other advantages. As one who is only a casual student of government I shall not venture upon this task, but I cannot help wondering whether Mr. Ireland includes Russia under the Czars and Turkey under the Sultan or the "Committee of Union and Progress" among the best governed nations or whether he may not be thinking rather of British colonies in which a highly enlightened race rules over an inferior or primitive one.

No doubt it is generally better for parents to govern young children than to make them absolutely self-governing; no doubt races of superior intelligence and morality can govern primitive races more efficiently than they can govern themselves; no doubt a wise and beneficent autocracy can accomplish many desirable things which an ignorant and corrupt democracy cannot. The question which lies back of all this is, What is the purpose of government? In the case of children is it not to bring them to a condition where they can wisely govern themselves? Is the purpose different in the case of primitive races or of the masses in a democracy? Is not the chief aim of government the highest possible development of the individual, the nation and the race?

In all kinds of development and evolution progress depends upon increasing specialization and coöperation, and this is as true of human society as of anything else. As a nation we have only recently emerged from the pioneer condition in which there was little specialization and coöperation but such a condition is not a necessary part of democracy and our people are rapidly becoming more highly specialized and more intimately bound together without becoming less democratic. Many faults of democracies are not so much results of the form of government as of the condition and character of the people.

Lack of specialization is said to be one of the fatal faults of democracy. Mr. Ireland says that in all other affairs of life we demand specialists and experts but "in government we are asked to

submit expert control to the inexpert." But lack of specialization is no essential part of democracy. Specialists in all fields of human activity are developed in democracies no less than in other forms of government, and if in selecting men for public office we still retain some of our pioneer ideals this phase of our development is rapidly passing. No doubt we often make mistakes in choosing men for public positions, but do other forms of government avoid such mistakes? In a democracy these mistakes may be quickly remedied; when we become sufficiently aroused "we turn the rascals out," but it is more difficult to get rid of a corrupt or incompetent autocrat.

Modern democracy is not the rule of the people as a whole, of ignorant masses, of "the blind God of Numbers." A democracy no less than an autocracy is a government by leaders, but in the former case these leaders are chosen by the people and are responsible to them and in the latter they are not. Leaders in a democracy have great power, and in great crises such as war, their powers may be temporarily greatly increased, but they are not autocrats for they must render to the people an account of their stewardship. In no modern form of government do the people as a whole make plans for war or peace, for taxation or legislation or even party platforms. These things are determined by leaders and in general the mass of the people hold them responsible only for results. Government, no less than personal behavior proceeds by the principle of "trial and error," and the majority in a democracy decides only whether the results are failures or successes. Furthermore a democracy is much more sensitive to this test than is any other form of government, for a failure is quickly abandoned and its authors repudiated. The contrast between democracy and autocracy is not between "numbers and rightness," but it is between rightness as measured by the effect upon the majority or on only a small minority of the people. Modern democracy demands, and has, experts even in matters of government, and who can truly say that the results are on the whole worse than in an autocracy?

The greatest problem which confronts all types of government is the problem of social coöperation. Efficient coöperation may for a time be forced upon a people by a powerful autocracy but history has generally shown that such a course ends in class antagonisms and the destruction of social union. Self-government and majority rule are generally recognized as the best form of government for intelligent people; a paternal form of government may be better suited to ignorant and undeveloped races, but only in case willing coöperation can be secured, for the end and aim of social evolution is coöperation without compulsion. A genuine democracy seeks and obtains a degree of coöperation which compulsion can never obtain. Ideal democracy means not less specialization but fuller coöperation than in other forms of government.

II

But it is not so much Mr. Ireland's views on democracy as on heredity to which attention should be called in this Journal. There is good evidence, as Mr. Ireland assumes, that acquired characteristics are not heritable and that mental and moral traits are inherited in the same way that physical traits are—namely according to the law of Mendel. Sexually produced organisms are mosaics of characters each of which is usually derived from one or the other of the two parents but not from both. These characters, or rather their germinal causes, the genes, are separable in hereditary transmission and in the forformation of the germ cells they are taken apart and in the fertilization of the egg new combinations are made. Good and bad traits are widely distributed throughout all classes of men, good and bad genes occur in all kinds of germplasm. East calculates that the gene or genes for feeble-mindedness occur in one person out of fourteen in the population of this country and undoubtedly the genes for superior intellect are also widely distributed. Even in obscure families a fortunate combina-

tion of good hereditary factors may give rise to great leaders, and in the most distinguished families an unfortunate combination of bad genes may lead to nonentities or worse. In short there is the sharpest distinction between the popular idea of heredity as expressed in the "law of entail" and the law of Mendel. Property, titles and privileges may be entailed but not personality, character or ability. No doubt the chances that good or bad traits may appear in offspring are much greater in certain families than in others, for while both good and bad traits are widely distributed they are not equally distributed. Nevertheless the actual facts show that great leaders do come from the lower levels of society as well as from the higher. Some of the greatest of the sons of men have had the most lowly origin. No one can predict today from what social level the great leaders of tomorrow will come. Many of the leaders in the present world crisis are men of humble birth, many who had the most distinguished lineage have been most dismal failures. Bateson somewhere comments on the great advantage it would be if only men could be propagated asexually as many cultivated plants are, for then it would be possible to entail character and ability.

Education or any other environmental factor can serve only to bring to development potentialities which are present in heredity, but, on the other hand, these potentialities would never become actualities except for the influence of education and environment. In every person many potentialities, some of them perhaps of the greatest value to society, remain relatively undeveloped, and this is especially true where popular education is lacking or in a society with fixed class distinctions.

Mr. Ireland asserts further "that assortative mating operates unremittingly to depress one end of the moral and intellectual scale and to elevate the other," that there is a "constantly widening gulf which separates mediocrity from talent, and the lapse of time is making talented families more talented and forcing others further and further below the line of mediocrity." If this is really true it should be easy to demonstrate, but I am not aware that any historical evidence has been or can be furnished for such a conclusion. No doubt if assortative mating among men could be directed and controlled as in the case of domestic animals such results as Mr. Ireland describes could be secured and indeed all except the most talented types might be eliminated, but as yet these are only theoretical possibilities so far as mankind is concerned. There is relatively little assortative mating of such a kind as would be necessary to bring about these results, and even where selection is most carefully made it is not continued for many generations along the same lines. When one considers the tendencies among the peoples of the earth as a whole, as over against these theoretically possible results of assortative mating, there is seen to be a great movement against fixed hereditary classes, even against national and racial segregation. Mating is determined by propinquity rather than by hereditary likeness, and such a method can never lead to hereditary uniformity.

In conclusion there seems to be no reason to conclude that heredity and democracy are incompatible. The law of entail is aristocratic but the law of Mendel is democratic. Democracy has never meant that all men are equal in intellect or character. It is not a denial of personal inequalities but is the only genuine recognition of them; on the other hand class or family distinctions disregard personal distinctions. No social system can afford to disregard the great personages who come of humble families or to exalt nonenities to leadership because they come of great families.

It is the creed of democracy that leadership should depend upon individual worth and distinction and not upon the greatness of some ancestor whose good qualities may have passed to some collateral line—but this is not the faith or practice of aristocracy. After

all the merits of any system of government should be measured by its actual results on society as a whole, over long periods of time, and measured in this way democracy has no cause as yet to be fearful of the results.

DISCUSSION OF ARTICLE ON DEMOCRACY AND HEREDITY

Madison Grant

THE Journal of Heredity for December, 1918, published a short article entitled "Democracy and the Accepted Facts of Heredity," by Alleyne Ireland.

The subject is of peculiar interest at the present crisis, and amid the popular clamor about socialistic democracy as a panacea for all social and political ills, it is refreshing to find an author who has the courage to stand firmly on historic facts and the lessons to be derived therefrom and to challenge the verdict of the masses.

In 1910 Èmile Faguet wrote the "Le Culte de l'Incompétence" and showed how banal, inefficient and tawdry the government of France had become in the opening decade of the twentieth century, but since then few voices have been raised to protest against the theory of government which entrusts the conduct of public affairs to the most incompetent members of the community.

The world war has had the effect of a rigid readjustment and of bringing the strong men to the front, especially in France, and in America also where the great heart of the people more than compensated for the mediocrity of the government. In military affairs this process of sifting proceeded rapidly, and it is probable that in Europe the administration of the armies was finally vested in those entirely efficient. The war did not last long enough, however, for America to replace the politicians by men of demonstrated ability at home.

In every branch of human activity, except government, we demand a certain amount of expert or technical knowledge, but apparently anybody is good enough to represent the public in a board of aldermen, a state assembly or even in the Federal Congress. There is no attempt made to require experience, knowledge or even a very high degree of personal character—and, least of all, does it seem to be of great importance, even for those who fill the highest positions in the nation, to possess long traditions of Americanism, without which no man can adequately represent the Republic.

Almost the only exception to the foregoing was the circumstance noted last autumn in Chicago that those candidates for various municipal offices who bore nondescript foreign names were one and all anxious to state that they were "born in America."

It is pathetic to note that in our American democracy the electorate having once accepted the theory that any man is qualified for any office without "distinction of race, creed or color," we proceed to limit and check the power of our chosen representatives by all manner of regulations, statutes and constitutions. This is in sharp contrast to England, which, being without a written constitution, has from time out of mind entrusted political power only to those classes which were deeply imbued with the unwritten traditions of the nation. If England ever falls into the hands of the Socialist Labor party it will suffer greatly from the lack of a written constitution because their new rulers will be devoid of respect for those great precedents of human justice and freedom

which have created and maintained the British Empire.

Alleyne Ireland's paper on democracy is a straight challenge to the relative value of heredity and environment. The extreme democratic, and still more the socialist, theory of government necessarily rests on the assumption that whatever inequalities exist between men or races are due to an unfavorable environment, and that, given an equal environment, which today spells education, the result will be the speedy obliteration of the differences between man and man and make them all equal in body, character and intellect.

This must be a very popular viewpoint, and this theory does commend itself most strongly to the lowest classes in every community, and in America it appeals to those races who, repudiated at home, have found here an hospital refuge. These classes and elements are noisy out of proportion to their number and are totally devoid of the American traditions of the past three centuries. To these classes and to these races, which have been previously denied, perhaps on the merits, access to social circles and to positions of responsibility, the breaking down of all barriers is most welcome.

This is Internationalism—a creed which finds ready acceptance among those individuals who, having neither flag, nor country, nor antecedents, nor traditions, nor language, nor even surnames of their own, are naturally desirous of abolishing these attributes or "privileges" in others. These men deny all discussion of race and raise the cry of "race prejudice" the moment the subject is opened.

Race, of course, is the greatest of all privileges and is the one thing that cannot be abolished by any human device except the actual killing of its possessor. In the last analysis the Bolshevist movement in Russia is a war of races. The Alpine peasantry, under Semitic leadership, are engaged in destroying the Nordic bourgeoisie, and with it the only racial elements of value in that great sodden welter of quasi-European peoples called "The Russias."

This objection to the discussion of race values, as I am informed, was largely responsible for the failure in France to take anthropological measurements during the war. In this country Mr. Ireland's paper will meet with violent protest from those races who feel themselves aggrieved by any classification or distinction among mankind based upon race.

If more Americans would come forward and say in print that which is universally stated and admitted in private conversation concerning the military, social and political value of the different immigrant races which have of recent years flooded our country, there would be a far more healthy reaction to the problems involved and less would be heard about a universal democracy bringing in the millennium.

In America the melting pot is an absolute failure. Immigrant races retain just what they brought with them, and some are good and some are bad. This is well-nigh universally admitted in private, but in public it is most unpopular to hesitate to bend the knee in servile adulation to the great god, Demos.

Our vaunted freedom of speech and of press in America probably is less observed than anywhere else among civilized men. If any reader doubts this statement let him try to obtain space in the public press for strictures on certain races and on certain religions; to make comments on their doubtful loyalty during the war; to mention their bias in favor of Old World antipathies; to discuss or disclose the shifty measures used to avoid the draft by some of these aliens; to point out the religious forces that lay behind the refusal of Australia or of Ireland to accept the draft and bear their share in the great world war, or to indicate the source of the opposition to the draft in French Canada. After such an attempt he will be quickly relieved of the idea that this is a free country.

It is, therefore, an act of no small courage on the part of Mr. Ireland to come forward and register a protest against the fatuous folly of the universal extension of the theory that all human ills can be cured by democracy and then "more democracy."

ARISTOCRACY AND POLITICS

Further Discussion of Mr. Alleyne Ireland's Article

PRESCOTT F. HALL

MR. ALLEYNE IRELAND'S article "A Biological View of Politics," in the December number of the JOURNAL, states a view with which many serious students are in sympathy, but which few have the courage to state. I say "courage" because the opposite view is so universal in popular discussion that it seems to be crying in the wilderness to preach against it.

The widespread and fatuous belief in universal suffrage and in what Goncourt called the "barbarism of number" is largely due, I think, to the increasing prevalence of a new psychological type. For lack of a better term I have coined the word "expansile" to designate it. Just as we have "motiles," "audiles" and "visuels," depending upon which sense is most active, so we have "expansiles," whose characteristic is that they are the victims of any idea which is broader or more inclusive quantitatively than some other. What bodily variation is correlated with this is not clear; but it may be a symbol, in the psycho-analytic sense, of claustrophobia, and may signify a reaction from the increasing urban life. The expansile tendency is especially marked in the desire for "equality" of any kind, this being a species of inclusiveness. In fact, in some persons, the lust for equality becomes a form of paranoia. Thus, if the discussion is of suffrage, everyone should have a vote; if of wages, everyone should have an equal wage; if of education, everyone should have an equal opportunity. The idea of proportional opportunity, by which those most gifted should have the best chance, is obnoxious to the expansile. The kind of thing often expressed in the phrase "brotherhood of man" implies the maximum of expansion and equality; although logically altruism is perfectly consistent with inequality.

The most disastrous example of false reasoning under the influence of the expansile tendency was provided by the French Revolution. It is well known that certain Masonic societies had a good deal to do with this event, notably the *Grand Orient* of France, and the *Philathètes* of Paris organized by Cagliostro. The false reasoning consisted in assuming that certain principles of equality, which had worked very well among the picked and chosen members of the lodges, could be extended at a stroke to the whole population of France. The writers of our Declaration of Independence and Constitution, being Masons, adopted the language of these principles when this country started on its separate existence. Fortunately, the population of the United States at that time consisted of picked specimens of the Nordic race, selected by the perils of voyaging hither and of exploiting a new country. These people had sense enough to entrust the management of their affairs to the most capable among them; so that, for some sixty or seventy years the government, although democratic in form, was aristocratic in fact. At the present time this is no longer true. Respect for intelligence and ability have so far disappeared that it is almost impossible for a strong and able man of independent views to be elected to high office. To get into office, a man must now play the demagogue.

The result is a lowering both of ideals and of execution. The popular opinion of the masses must be consulted at every step. Amiel says: "The stupidity of the Demos is equalled only by its presumption. It is an adolescent who has power but cannot attain reason . . . Democracy rests on the legal fiction that the majority has not only power but reason, that it possesses wisdom as well as legal rights . . . The masses will always be below the average, . . . and

democracy will end up in the absurdity of leaving the decision of the most important questions to those most incapable. This is the penalty for its abstract principle of equality . . . which ignores the inequality of valor, or merit, of experience, in other words, of individual effort."

Many champions of the view that intelligence and ability should have no more than their numerical proportion of power in government, in other words, those who believe in government by "counting noses," admit more or less of Amiel's indictment. But they contend that, although democracy in Plato's words is the best form of bad government, it is essential to the education of the people. These persons forget that psychology has shown that the larger part of education consists in imitation and emulation. If the thing before the eyes of the next generation is bad, that is the thing it will imitate and emulate. When a jailbird is elected to high public office, what is the influence on the young politicians and voters? For, as Mr. Ireland points out, if education is not transmitted by heredity; if only the psychic environment is handed on in the form of institutions, books and records, the process of information has to be done over in every generation, and if at any time the institutions have changed for the worse, the educational facilities are lowered also.

The more intelligent a community, the more it tends to recognize and venerate ability and merit. In an intelligent electorate, the *aristoi* always have more than their numerical quantum of power, even under democratic forms. Hence there democracy works relatively well. But elsewhere, and especially under all forms of "pure democracy," this is not so. The matter is further complicated by the demand for socialism. As Èmile Faguet points out, democracy, having for its principle equality of political rights, is the greatest breeder of aristocrats; for there is complete freedom and inequality as regards natural conditions. As soon as this is perceived, socialism demands equality also in these natural conditions; hence socialism is as directly opposed to democracy as aristocracy is, but with the difference that it seeks to level everything instead of favoring the best.

Mr. Ireland seems to me entirely right in holding with Nietzsche, Schopenhauer, Renan, James and many historians, that great men lead their age, instead of being the result of their environment; and no doubt he would agree that progress is to be measured by the achievements of the greatest rather than by the condition of the average. As a matter of fact, as Lecky and Mallock have shown, pure democracy is an impossibility, except in a relatively small area where the people are intelligent and homogeneous in character if not in race. Elsewhere, it is simply a question of what kind of oligarchy shall govern; for there will be an oligarchy either of aristocrats or of demagogues and bosses. By aristocrats I mean those of special intelligence and ability. These qualities, as Mr. Ireland shows, are in general hereditary; and in the early days when the Nordic race overran Europe, it rightfully became the aristocracy of Europe by virtue of the possession of these qualities. At a later period, for various reasons, the identity of privilege and ability no longer held good in many cases; so that I am not now contending for special power based solely on ancestry.

But even where the better sort of men have the leadership, they are often subject to the temptation to weaken it for the benefit of a temporary advantage. Nearly every extension of the suffrage has been the result of a bargain in which some party in power has traded the public good for the adherence of some faction hitherto denied the ballot, and usually in the name of progress and reform. Ludovici has pointed out the deterioration in the British House of Lords through the successive creations of life peers, mostly made to tide over some political crisis; and that the addition of men unused to legislation, even though able in other lines, weakened the average capacity of the House. The same thing can be said of the broadening of the electorate itself. And yet the recent abolition of plural voting in Belgium has been hailed as a step on the

road to the New Jerusalem! In this country, so far as I am aware, there have been only three cases where the suffrage has been changed from a broader to a narrower basis. In early Massachusetts, it was limited by a vote of all the colonists to church members and property owners; in New Jersey, woman suffrage was abolished early in the nineteenth century; and in Rhode Island, the property-owning qualification of $75 was recently raised to $300.

In my opinion, we never shall have good government until the suffrage is limited to those having a certain education, or paying a certain tax; perhaps also allowing those to vote who are willing to pay a fee for the privilege. We never shall have good financial management in cities where, as in Boston, 118,000 non-taxpayers spend the money of 18,000 tax-payers. For, taking things on the average, as we always have to do in sociological questions, the liability to a tax implies a certain measure of success and ability. That is why the Bolshevist, who is a mentally and nervously irritable person, filled with hate in the form of envy, is so against property as an institution.

Limitation of the suffrage may seem impossible of accomplishment in these times, when we are seeking the smallest possible political unit, even as we try to split up the atoms of physical matter; and yet, if everyone would speak out who desires it, the achievement might not be so remote. Perhaps the most pregnant saying of Goethe, which embodied a generalization from his wide study of biology and other sciences, was that anything to succeed must have "Beschraenkung"—limitation. Goethe was not what I have called an expansile. He would doubtless have recognized that the chief danger of the American people today is the tendency to follow out logically abstract ideals without reference to the concrete situation. This, as LeBon has shown, is a tendency indigenous to the Latin but not to the Nordic spirit. We are developing it partly through the dilution of our national character by immigration, and partly by hearkening to the catchwords of expansile leaders and those who wallow in humanitarian platitudes.

Therefore we should all be grateful to Mr. Ireland for stating the case so clearly, and for his testimony to the value of aristocracy, based on his long and thorough study of various experiments in government.

Plant Breeder's Envelope

The plant breeder's envelope, described in the following paragraph, worked admirably on tender succulent flax plants and ought to be of use for other delicate plants. It has the advantages of being light in weight, insect proof, moisture proof, and of being readily adapted and used. (Fig. 6.)

A piece of oiled paper is folded or doubled the desired width, with an additional inch or two which is to be left unstitched to facilitate opening the envelope. A sewing machine is used to stitch off as many envelopes as the length of the folded sheet will permit. The envelopes are cut apart with scissors and slit up through the middle of the unstitched portion at the base. At the crotch of this slit a hole is cut of sufficient size for the plant stem to fit snugly when enclosed. One half, section B, of the unstitched portion is folded lengthwise towards the top of the envelope. The other half, section A, is folded on a forty-five degree slant over the first half. Points c, d, and e coincide, and at this corner where the folded parts overlap a snap fastener such as is used on women's dresses is used to fasten the envelope base together. The plant breeder's envelope is now in the same position as when enclosing an emasculated flower on the stem of a plant. The unstitched portion at the envelope base must be one-half, or less than one-half, the width of the envelope in length so that, when folded, there will be no unstitched portion above the fold.

Robert L. Davis,
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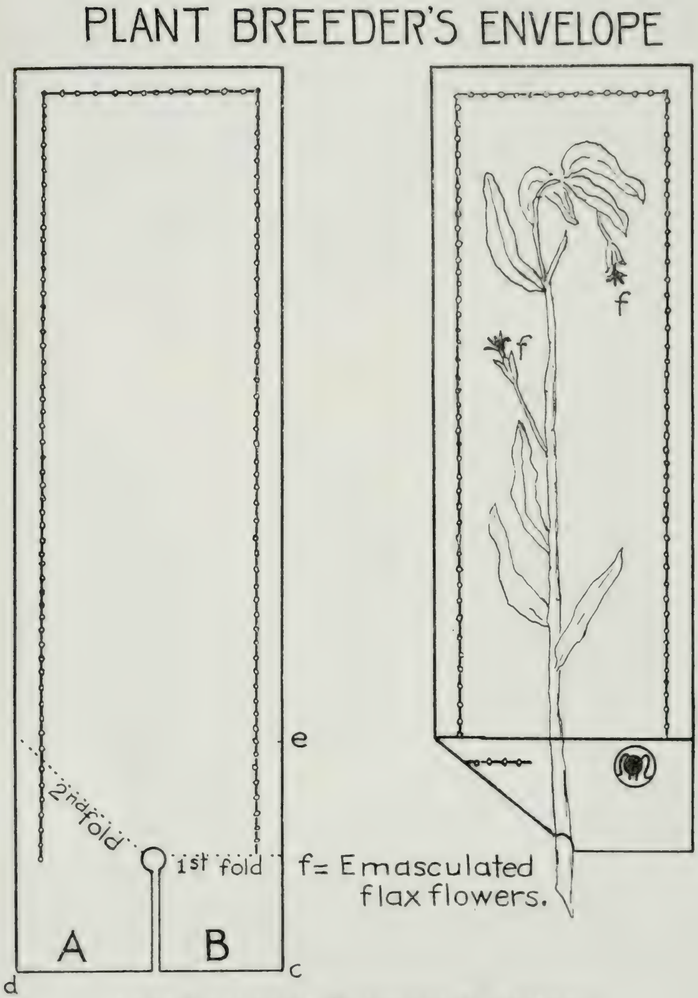

A PRACTICAL ENVELOPE FOR PLANT BREEDERS

It has the advantage of being light in weight, insect proof, moisture proof, and of being readily adapted and used. See description on opposite page. (Fig. 6.)

A FOSSIL EAR OF MAIZE

First Tangible Evidence of the Existence of Indian Corn in Geologic Times

G. N. Collins

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DR. F. H. KNOWLTON has recently published the description of a fossil ear of maize from Peru.[1] The specimen, which is described as a new species, *Zea antiqua* Knowlton, was purchased from a collector of curios in Cuzco, Peru, in 1914. In spite of its unsatisfactory history, the specimen is of especial interest since it affords the first tangible evidence of the geological existence of this important cultivated plant.

It is well known that maize or Indian corn was grown widely in North and South America before the time of Columbus. How long before, there is as yet no way of determining. A very long period is indicated by the fact that the progress made in the improvement of this plant since the discovery of America is insignificant in comparison with the changes that must have taken place since the prototypes of maize were able to exist as wild plants. Not only were the kinds found growing by the earliest explorers similar to those now cultivated, but remains of ears found in prehistoric graves are almost duplicates of the varieties grown in the same regions today.

The finding of a fossil ear means that the origin of maize may now be transferred from prehistoric to geologic times, for Dr. Knowlton is confident that, although the specimen may not be assigned to its exact geological period, it is an undoubted fossil. Yet the type it represents is domesticated maize essentially like the varieties still being grown in Peru and Bolivia.

Mexico is generally thought to be the region where maize was originally domesticated. The chief reason for assigning the origin of maize to Mexico rather than to South America is the important fact that Mexico is the natural habitat of teosinte, the nearest wild relative of maize. On the other hand, the great diversity of types existing in South America certainly bespeaks either a very great antiquity or a multiple origin.

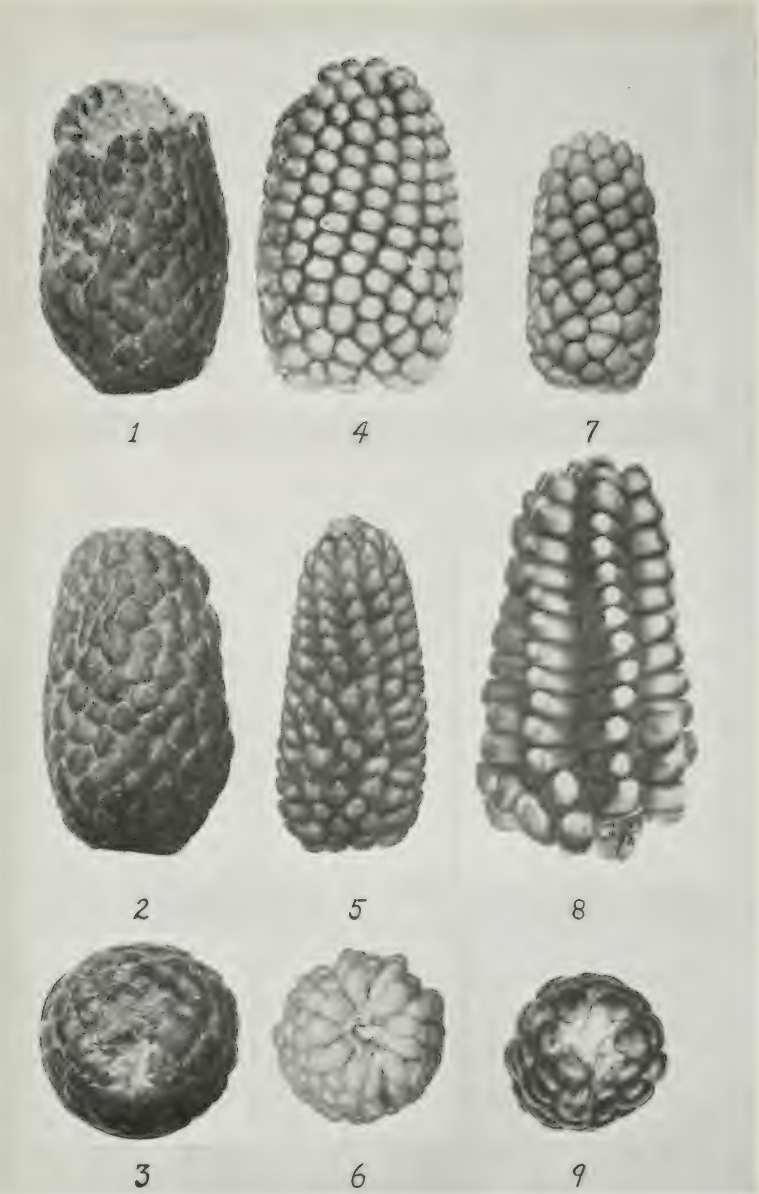
Prior to the discovery of *Zea antiqua* the most ancient evidence of maize was the specimens found by Darwin[2] who unearthed "heads of Indian corn," mixed with marine shells and earth on an elevated ledge on the island of San Lorenzo near Callao, Peru. The ledge on which the relics of maize were found was elevated 85 feet above sea level. The shells which accompanied the maize specimens belonged to recent species and were covered with a few inches of detritus. Darwin states that the maize and human remains "had all indisputably been embedded with the shells."

The ear of *Zea antiqua* is 60 mm. long and 35 mm. in greatest diameter. The apical portion is missing but the original ear must have been about 80 mm. in length. The butt is rounded and the ear is strongly tapered, there being no portion even approximately cylindrical.

The seeds are from 4 to 8 mm. in length and from 3 to 5 mm. in width, sharply pointed and irregularly disposed. The seeds on one side of the ear at some distance from the base are somewhat smaller and more irregular in form, making the ear slightly asymmet-

[1] Jour. Wash. Acad. of Sci., Vol. 9, No. 5, pp. 134-136, March 4, 1919.

[2] Darwin, C. R., "Geological Observations on Coral Reefs, Volcanic Islands and on South America," Pt. II, pp. 47-49, London, 1851.



FOSSIL MAIZE AND MODERN MAIZE

An ear of fossil maize (*Zea antiqua*) compared with existing South American types. Nos. 1, 2 and 3, different aspects of the fossil ear; No. 4, a Bolivian variety from high altitudes; Nos. 5 and 6, a Peruvian popcorn from Ollantaytambo; Nos. 7 and 9, Copacabana variety from near Lake Titicaca; No. 8, a Peruvian variety called Granada. (Fig. 7.)

rical. Asymmetry of this kind is frequently observed in varieties which have the ears closely oppressed to the culm. If this analogy is correct, the aspect shown in Fig. 7, No. 1, is the axial side of the ear. The articulation of the seeds with the cob can be readily made out and individual seeds are easily detached. The structure of the cob is not apparent, at least without sectioning. The seeds extend around the base indicating that the pedicel must have been very small. In size and shape the specimen is similar to the ears of Peruvian and Bolivian varieties, illustrations of which are shown with those of the fossil ear in Fig. 7.

The gradually rounded butt is not an uncommon character and is well illustrated in Nos. 4, 5 and 7. The shape of the seeds cannot be exactly duplicated by any specimen in our collection, but is not unlike those of a Peruvian variety of pop-corn shown as No. 5 that was grown near Ollantaytambo. Pointed seeds are a common characteristic of Bolivian and Peruvian varieties, but they are usually much larger than those of *Zea antiqua*. An example of these larger pointed seeds is shown as No. 8. The irregular arrangement of the rows is approximated by specimens of the Copacabana variety from the region of Lake Titicaca, No. 7.

The extent to which the base is covered by the seeds seems almost to preclude the possibility of a pedicel able to hold the ear in an upright position. Equally small pedicels are, however, not uncommon in Peruvian specimens. See Nos. 6 and 9. In existing varieties having very small pedicels, the pedicels are also short and the ear is supported chiefly by the subtending leaf-sheath.

While the fossil ear is not duplicated by any ear in our collection, it presents no new characters, but rather a different combination of characters found among the existing types.

Differentiation of Bright, Medium, and Dull Pupils

Anyone who visits a typical public school in which the pupils of each grade number thirty or more can scarcely avoid noting marked differences between pupils in a single grade in the facility with which they assimilate knowledge of the subjects being taught.

It is becoming a well-recognized fact that a pupil who falls in the first group in one subject tends to fall in the same group in all subjects, and that the same is true of pupils falling in the second or third groups. There may be, here and there, marked exceptions to this rule, but it is true in general. One is naturally led to the conclusion, therefore, that the pupils of the second type mentioned simply lack the general mental capacity to assimilate knowledge as rapidly as the other pupils, though their having passed the grade below would seem to indicate that if given sufficient time they could understand the subjects under discussion, at least fairly well. One is led to conclude also that the pupils of the third type mentioned possess a degree of native mental ability which enables them to acquire knowledge more rapidly than do their fellows.

The almost inevitable outcome of such maladjustment is the premature quitting of school and the consequent misfortune of a half-finished education accompanied by a feeling of malevolence toward the school and society.

Perhaps the chief purpose of intelligence measurement, then, is the scientific (as well as rapid and accurate) classification of pupils in regard to their native capacities to learn, in order to provide for the separate teaching of pupils of marked differences in ability to progress in school.—*From the Preface of a Manual of Directions for Administering the Otis Group Intelligence Scale, World Book Company, Yonkers-on-Hudson, N. Y.*

THE FIGHTING ABILITY OF DIFFERENT RACES

(Second Letter)[1]

France, *December* 6, 1918.

AS I'VE told you before, the Normans and North French finally made up the fighting troops of France that could be depended upon in disaster as well as victory, the infantry that held and went forward. The Bretons, too, were tough and steadfast fighters but seemed to lack something of the madness of the Normans and North French on occasions for a grand gesture.

On the front the number of big, burly, blond Frenchmen amongst the officers seemed to me striking, while blue eyes were almost in the majority—more than one of our officers and men have remarked in my presence on this fact and on the stature and blondness of the French officers and fighting men. It was so contrary to their preconceived notions.

Of course you know the British and their qualities too well for me to have to record them. The Scotch most of all were the natural fighting men of the war—the ones who actually took joy in it more than any of the rest. The love of fighting was a great source of weakness to the British more than once, as it was more than once with us, too, The Scotchman seems to be a sort of drunken madman in a fight. Fear of death does not appear to bother him in the least. And the few Scotchmen in our regiment were the best and most reliable noncoms we had. McKinzie and Knox, two noncoms of my old battery, particularly distinguished themselves in trying situations, acting with coolness and courage that were highly commendable.

Amongst our own highly heterogeneous troops the fighting ability of an organization usually could be measured by its percentage of Americans of the old stock. And as outfits were filled up by draft "replacements" the fighting ability perceptibly waned. This is stated by the officers who commanded the platoons and companies and battalions in the fighting. Of course the entire army was officered by Americans of the old stocks almost 100%. The exceptions are quite negligible. The Irish are awfully good fighting leaders. But the number of Irish names is not conspicuously large.

I am quite sure the New England troops were our best—the northern troops infinitely superior to the southern in "guts," discipline and fighting ability—though the southern officers were conspicuously brave and able all around with a fine faculty for true leadership.

The 77th Division seems to have been a curious contradiction since it was made up of the scum of New York City, all drafted and of all races, Jews, Italians, Poles, and Russians. And it was really a wonderful fighting outfit. It was officered by American gentlemen, however, and their leadership was equal to anything shown in the war. The things they did with their city scum were really heroic, again and again, and equalled any of the mad, forlorn hopes that the mad Highlanders or the stubborn English ever pulled. The Jews seem to have displayed lots of "guts" too (when they were in fighting units), but they were wonders in getting into the safer branches of the service.

The Mediterranean peoples seem to have been least able to stand shell fire, gas and the general hell of the game. It is more than a coincidence that officer after officer has told me of

[1]Received from Madison Grant. Written by an American Army Officer. For the first letter and accompanying discussion see Journal of Heredity for January, 1919.

Italians, privates and noncoms, who broke, quit cold and lay down like curs all of a sudden after fighting with dash and courage up to a certain point. They lack the character to "carry on" to the finish. You cannot rely on them at all. The Slav is a mirror—he is what his officers and comrades are. But he is poor stuff—a childish-minded, unstable, moody animal, and seldom over-burdened with loyalty and reliability. It's a shame to think the clean blood of the old American stock is going to continue to be contaminated and debased by these things from south and eastern Europe. Is there no way to stop it? Again and again I've heard officers here say, "There's just one fighting man in our army—the American!" And when he said "American" he excluded all Wops, Polocks, Slavs, Turks and Asiatics, and we all knew what was meant.

The negro failed utterly under his own color, but officered by white men he was pretty good! Indeed the negro officer is perhaps the most pitiful thing in the whole war. He failed through no fault of his own—but his color. The negro soldier had no respect and no confidence in his black officer. No matter how good the black officer is, he is first and always a nigger in the eyes of other negroes. And leadership is surely based on nothing but confidence, —bluff, if you choose to call it so. And no negro can bluff another negro.

The Indians I've heard of and seen (only a few) have all been good, nervy men and very good soldiers, natural soldiers in every way. And they seem to take naturally to war, shellfire, gas and all. I've heard nothing but good words for them from officers who commanded them and whom they fought under.

But no fighting man in the war was the superior to the real, tall, lean, blue-eyed, tow-headed *American* doughboy—our American, I mean. A red-headed second lieutenant told me of a party he pulled with a bunch of real Americans who had been without food for thirty hours and for half a day without water. The Boches pulled a counter attack on them at dusk after harassing them all day with shells and grenades. He said he told his men to "go out and meet them" and not to retire until they heard his whistle blow. He said his men went out at 'em with howls like madmen before he'd given the word. He said the crash of the meeting of the two bodies of troops was really tremendous and that he could not bring his men back from the pursuit till they had driven the Boches a kilometer northward. Several men he had to threaten with his revolver to force them to retire. "Just let me get *one* more, Lieutenant, just *one* more, Sir! Please!" they'd beg him. And the bayonet and butt was the order of the fight on our side all through. It's so typical of the stories the doughboy officers tell that it must be our fighting way, the national method of getting at 'em.

The devil of it is that the Americans got bumped off too fast—and the replacements were too often "not there." In the papers the "draft army" is O. K., but we know about it. You had the right dope in the Great Race. It is the great race and no mistake.

WINGLESS WYANDOTTE, MOTHER OF NORMAL CHICKS

Photograph showing a sudden mutation which may be recessive, as this hen, when mated to a normal male, has produced only normal offspring. It is possible that the mutation may be of embryonic origin and not carried in the germ-plasm. (Fig. 8.)

A Wingless Wyandotte

The pullet shown in the illustration (Fig.8) was hatched in April, 1918, from a flock of normally formed White Wyandottes. The male of the flock was not related to the females. The pullet was born without wings or any sign of same. At the spot where the wing should join the body on either side of the bird, there is what might be called a "cow-lick" of feathers. This chick was the only abnormal one of those hatched from the flock with the exception of a cockerel which was born without a tail, having no "parson's nose." The pullet weighs 5½ pounds, and has been laying steadily since December 1. She has been mated to a normal unrelated cockerel of the same breed. Up to the present all her chicks have been normal. Since January 1, the pullet has started to leap and can now easily leap to its roost, 2½ feet from the ground.—J. R. Terry, *Department of Agriculture, Victoria, B. C., Canada.*

Develops New Hybrid Cowpeas

In its plant-breeding work with cowpeas, which involves several hundred hybrids and selections, the United States Department of Agriculture during the past year has developed several new sorts. These varieties are Potomac, Arlington, Columbia, White Hybrid, and Early Buff. Extensive field work is being conducted by the department with hybrids, especially in the wilt and nematode lands of the Southern States. Two hybrid selections, unnamed as yet, have been found highly resistant to both nematodes and wilt and are superior to other sorts for the production of seed and forage. These two selections are being grown in quantity for more extensive field tests next year.—*Weekly News Letter, United States Department of Agriculture.*

DOMESTICATION OF ANIMALS IN PERU

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SEVERAL misapprehensions appear in an article published in *Science* for March 15, 1918, p. 268, under the title "The Domestication of the Llama." Reference is made to an argument that "thousands of years must have gone by before the llama and its kindred, the alpaca, the vicuña, and the huanacu, could have been brought to their present state of domestication." Instead of four kindred species having been brought into domestication, there seems to have been only one. The vicuña and the huanacu are not domesticated animals, only the llama and the alpaca, and both of these are supposed to have been derived from the huanacu. Certainly they are not more different than some of the varieties of other domesticated species. Though distinct breeds are not separated, there is much diversity in size, form and color, as well as in the length and texture of the wool in the llama, as well as in the alpaca. If a common origin from the huanacu be denied, it is necessary to assume the former existence of another wild species, the vicuña being too different to figure in such a calculation.

Both of the wild types, the huanacu and the vicuña, are extremely shy, retiring and fleet, like deer or antelope. If caught young and raised in cages, they may become tame, as do most kinds of deer and antelope, but even the domesticated llama is hardly "a docile animal by nature." It is a stupid, unwilling and resentful beast, in some respects like the camel, in others like a sheep. It shares the camel's habit of blowing its nose when offended, but is too small to ride and lacks the physical endurance of the "ship of the desert." Alpacas are somewhat smaller than llamas, are seldom trained to carry burdens, and are herded with the female llamas on the grazing lands of the high plataus. Of the alpaca it is said that an individual animal cannot be driven away from the herd, but the llama is also strongly flock-minded.

If animals that "feed themselves" and "do without shelter" are only "partially domesticated," not only the llama, the camel and the reindeer, but the sheep, cattle and horses of many countries would fall into this category. With even a little freedom most of our domesticated animals will seclude themselves from mankind or revert to hostile instincts at the breeding season, and hostile propensities are also shown habitually by some individuals of our most domesticated species, dogs, cats, pigs, sheep, cattle and horses.

One of the most completely domesticated creatures is the *cuy*, or guinea-pig, also a native of Peru. This animal meets all the "criteria of domestication" in which the llama is said to fall short. The cuys are sheltered, fed and bred in the houses of the Indians, show no hostility or fear, and refuse even to crawl over a threshold raised a few inches above the ground. Yet the wild cuys are extremely shy, and this ancestral trait persists in hybrids, even when the proportion of wild blood is very small.

A general result or consequence of domestication in mammals is the breaking up of the specialized and finely-graded distribution of the hair colors

YOUNG ALPACAS AND LLAMAS

A flock of young alpacas and llamas, mostly uniform or self-colored. The longer and more erect ears distinguish the white llama near the middle of the picture. Longer and denser wool on the head, neck and legs makes the alpaca appear more clumsy, and the neck is not so long nor so straight. Photograph by Hiram Bingham, courtesy of the *National Geographic Magazine*. (Fig. 9.)

LLAMA PACK-TRAIN

An unloaded llama pack-train, in Sicuani, Peru, with the Indian drivers. Three colors are usually represented, black, brown, and white, with mixed and particolored coats not infrequent. Photograph by G. B. Gilbert, April 10, 1915. (Fig. 10.)

ALPACAS FEEDING

Alpacas feeding on bunch-grass pastures near Araranca, Peru, in the Pass of Raya, at an altitude of over 14,000 feet. Several of the lamb-like young animals in the foreground are notably particolored. Photograph by G. B. Gilbert, April 13, 1915. (Fig. 11.)

of the wild species into solid colors, coarse patterns or irregular spots, accompanied by partial or complete albinism and other abnormal features. Great diversity exists among the domesticated cuys in Peru, an example of which was noted at an isolated Indian house at Machu Picchu in May, 1915. With less than a score of animals there were white, black, brown and gray coats and four shades of red and buff, including a dark mahogany, a paler red, a bright buff and a dull buff, also a pale buff gray, distinct from a black and white gray. Red eyes were noted with buff and white coat, a gray and white coat, and a coat that was entirely black, except for a white stripe on the face. Some individuals were rough, with the hair turned in all directions, and some had lop-ears. More extended and detailed investigation has been given to the color variations of guinea-pigs than to those of any other animal, and the chief authorities in this field have stated the following general conclusion:

"It can be stated, therefore, with probable correctness, that the guinea-pig has undergone in domestication more extensive variation in color and coat characters than any other mammal, and that this variation has occurred almost if not quite exclusively under the tutelage of the natives of Peru. This conclusion points either to a great antiquity of the guinea-pig as a domesticated animal or to more rapid evolution by unit character variation than by other natural processes."[1]

In addition to the llama, alpaca and cuy, the ancient inhabitants of the tablelands are known from the evidence of remains found in ancient cemeteries to have had at least two very distinct types of native dogs, one like a shepherd dog, described by Nehring as *Canis ingae pecuarius*, and another which is compared with a bulldog, *Canis ingae molossoides*. In the warmer valleys, according to von Tschudi, the small hairless house-dog, *Canis caraibicus*, was the prevailing type. The name *perros chinos*, applied to the hairless dogs in Peru, instead of indicating a Chinese origin, may correspond to such expressions as "house-dogs" or "lap-dogs" in English, *china* being a word for woman in the Quichua language.

The fact that the ancient Peruvians and their neighbors had several domesticated animals while the Indians of other parts of America had only dogs, has led some writers to consider the Peruvian tablelands, instead of the warmer valleys, as the original seat of development of the ancient Peruvian civilization. It has long been supposed that a pastoral state preceded the development of agriculture in the Old World, an idea borrowed from the traditions of the Jews, Greeks, and other Mediterranean peoples.

It is possible, however, that the pastoral nations of antiquity secured their domesticated animals from their agricultural neighbors whose crops also they eventually adopted, just as our western hunting Indians began to keep horses, cattle and sheep many years before they settled down to farming. Dogs might be domesticated by savages, but such animals as sheep, cattle, horses, camels, and llamas, seem much more likely to have been domesticated by settled agricultural peoples, than by nomadic hunting tribes. Hunting tribes were numerous in America, and many had adopted only one or two crops, but there were no strictly pastoral people, none who relied on domesticated animals instead of on plants. The ancient Peruvians, who went farthest in the domestication of animals, had also the most highly developed agriculture, the most numerous crops and the most specialized methods of farming.

[1] Castle and Wright. Studies of Inheritance in Guinea-pigs and Rats, Pub. 241, Carnegie Institution, Washington, p. 6.

That any definite evidence of "immense antiquity" can be drawn from the domesticated animals of the ancient Peruvians is not of course to be expected. The most that may be possible is to gain relative ideas of the antiquity of domestication in America and in the Old World. The opportunities of such comparisons are better with plants because of the much greater number of domesticated species. From such considerations as seedlessness and wide divergence from the nearest wild relatives, the series of American crop-plants appears to be older than the "Old World" series.

Do Birds Show a Monogamous Instinct?

Recent numbers of *Condor* have contained several articles on the marital tie in birds, even discussing the moral issue involved, constructing a sort of bird morality. The contributors do not appear to have settled the question. L. H. Miller, whose article is quoted in part as follows, makes the suggestion that seasonal mating may be necessary to maintain the vigor of the race.

"In the *Condor* for October, 1918, Mr. F. C. Willard contributes a most stimulating article dealing with the question, 'Do birds mate for life?' In support of his affirmative contention he brings forward some observations resulting from his extended field work in southern Arizona.

"His article is good and the facts recorded are unimpeachable. The interpretation of facts, however, introduces the human element into science, and hence offers a basis for divergence of honest opinion. It is not my desire to dispute Mr. Willard's conclusions but to offer, wholly in good faith, some remarks in support of the opposite side of the question, so that each reader may be his own judge, jury, and court of appeal.

"My first contention is that a bird's activities are almost wholly the result of instincts. These instincts are racial characters and are transmitted from generation to generation, no less truly, though perhaps more variably, than is color, size, or wing area.

"My second contention is that instincts are dependent for their stimulus upon the physiological condition of the animal. Recent experiments on internal secretions have been performed by the transplantation of reproductive glands or by the infusion of tissue extracts directly into the blood stream. These experiments have some bearing upon our problem in that they go to prove that plumage differences between the sexes of poultry are directly controlled by the presence in the body of these germ cells, and that many instinctive acts are dependent, for their immediate stimulus, upon the activity of these glands. A young capon in whose body the ovaries of a hen are grafted will develop the feathering characteristic of the hen. The capon, without the engrafted ovaries, will develop almost as the normal male. A normal female rabbit, treated by hypodermic injection with the extract of foetus in normal salt solution, will pluck the fur from her breast and build a nest as though expecting a litter of her own young, though none are developing.

"The theorist, however, feels it proper to ask the question: Are there not biologic reasons why a seasonal readjustment of the marital relation would prove advantageous to the race? If a protracted effort is required each season before a mate is obtained, the less virile bird will go unmated. Would not the result average better for the maintenance of tone in the race? Whatever else may be claimed for the principle of sexual selection, it seems to be more or less vital to racial vigor. Seasonal recurrence of the selective process would then be classed as a sort of protective adaptation in a class of animals showing abundant specialization in other respects.[1]

[1] Loye Holmes Miller, The Marital Tie in Birds. *The Condor*, vol. 21, March-April, 1919.

TWINNING IN ALFALFA

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DURING our Alfalfa investigations in the season of 1918, the twin hybrid seedlings as illustrated in Fig. 12 appeared. As this is the first time that twinning in alfalfa seed has been noticed in our work, it is thought that a short account of the parentage of the plants giving rise to the twins may be of interest to other investigators who may possibly have had a similar experience.

In raising alfalfa hybrids, the method practiced in this department is first to germinate the seeds in small quantities in open pans, then to transfer the sprouted seeds to prepare soil in flower pots of shallow flats. Finally, after the plants are sufficiently well developed, they are planted out in plots in the open field. It will be seen that this system enables the worker to note any peculiarities which may arise during actual germination, which might otherwise pass unnoticed. The parent of the twins shown in Fig. 13 is the recent progeny of a series of crosses commenced in the summer of 1911.

THE ORIGINAL CROSS

The first cross of the series was made between alfalfa as the female parent and Black Medick as the male parent, from which, in 1912, twenty-four F_1 plants were raised.[1]

THE SECOND CROSS

In 1913 a plant of the F_3 generation of the original cross was crossed with pollen from White Sweet Clover. From this second cross, five F_1 plants were raised, four of which produced a few seeds; the fifth plant was totally sterile. Many attempts were made to induce this plant to produce seed, both by selfing and by back-crossing with both original parents, but all efforts proved futile, the plant remained sterile throughout. In order to perpetuate this plant, cuttings were taken from it in 1914 and about twenty plants propagated. Much to our surprise, most of these plants in the following year produced a small quantity of seed. In the spring of 1916 a portion of the seed thus obtained was germinated and eleven plants reared.

THE THIRD CROSS

In 1917 two out of the eleven plants were back-crossed, White Sweet Clover being again used as the male parent. From this cross seven F_1 plants were raised, one of which produced forty-two seeds, one of these seeds producing the twins as herewith illustrated. (Fig. 13.) In addition to this pair of twins, two other pairs were found. These two pairs likewise descended from the same original cross as the first pair, but the subsequent crossings were both different. In one case the parent which produced the twin seed was obtained by inter-crossing two F_3 plants from the original cross. In the other case the parent of the twins was obtained as a result of back-crossing an F_2 plant from the original cross, using Black Medick as the male parent.

SUBSEQUENT BEHAVIOR OF TWIN SEEDLINGS

Of the first pair of twins, one produced a strong healthy plant and the other died from exposure. The remaining two pairs developed into strong vigorous plants, and, though the members of each pair varied somewhat in size, yet each pair seemed to be quite identical in botanical characteristics. Of the five surviving plants, four produced a few seeds which will be used for further investigation.

[1] See "Alfalfa Hybridization," Journal of Heredity, vol. v, No. 10, pp. 448–457.

TWINNING IN ALFALFA

Two alfalfa seedlings obtained from a single seed. Enlarged about four times the natural size. (Fig. 12.)

TWIN ALFALFA PLANTS

These plants, about three months old, were produced by one seed. This seed was obtained from a mother plant which was the F_1 progeny of an inter-cross between two F_3 plants obtained by crossing Alfalfa ♀ with Black Medick ♂. (Fig. 13.)

BRAZILIAN PLANT SIMILAR TO TOBACCO

It is difficult to get a horse to go by *Solanum bullatum* until he has had a good chew. It is an excellent forage plant and should be more widely cultivated. (Fig. 14.)

A FORAGE PLANT FROM THE SOLANACEAE FAMILY

A Plant That When Young Is Very Similar to Tobacco and Much Appreciated by Horses in Brazil

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LOOKING through the books on forage plants under common cultivation none are to be found belonging to the genus Solanum, nor to any other subdivisions of the Solanaceae family. The following notes on the *Solanum bullatum,* a promising forage plant of this family found wild in many parts of Brazil, are made from the standpoint of the agronomist and not so much of the botanist. Some time ago our attention was called to this plant by the articles in the Brazilian papers by the botanist, Dr. Alvaro A. da Silveira, whose work with little known plants suitable for forage purpose has been notable.

This plant has many common names in Brazil, differing in each state. In Minas it is called *capocira branca* (white bush) and *fructa de pomba* (dove fruit). The first name is given on account of the whitish tinge of the leaves, especially as the plant gets older and grows into a small tree. The second name is given to it because the wild doves are very fond of the fruits; indeed, it is very hard to get seeds of the plant because the birds pick them before they are ripe. In São Paulo the common name is *cuvetinga,* which is probably the native or Indian name for it. In the State of Rio de Janeiro it is called *fumeiro,* or tobacco plant, because as a young plant it is very similar to the tobacco plant. It is also found in the State of Paraná and possibly in other states.

As a young plant it grows up as a bush with a number of stems coming up from the ground, but when older it is often found with only one trunk. Where it grows isolated it spreads quite widely (see Fig. 15), but when growing in very rich ground and along with other plants it reaches a height of 15 to 20 feet.

After a forest is cut off and the land turned over, among the first plants to appear is the *Solanum bullatum,* and its usefulness as a forage plant came to be noticed in that way. As soon as fresh land is cleared it is planted to corn. When the corn crop is harvested the cattle are turned in to eat off the stalks, and as this plant is generally to be found it was noticeable to what extent the cattle sought after it. When riding over our land it was often noticed that a horse would leave the road to try to get a nibble at this plant. One horse we owned could safely be ridden through a cornfield without his biting the corn, but it was difficult to get him past one of these plants without getting his mouth full. So far as we know no toxic effects have been observed from cattle or horses eating this plant. We were informed that, while it was not injurious to horses, it was poisonous to cattle, but this information is incorrect, for cattle are just as fond of it as horses and no ill effects are noticeable with either.

If it should be cultivated it would have to be planted close enough together in the rows to be utilized before it got too big or woody. It is perennial, but as a forage plant would have to be used as an annual. It will sprout from a cut trunk, but this would probably not prove to be of advantage agri-

BRAZILIAN FORAGE PLANT

This plant when young resembles so much the tobacco plant that it is called "fumeiro" in the State of Rio de Janeiro. Horses and cattle are devoted to it, and it seems to agree with them. Chemical analysis shows an unusually high protein content. (Fig. 15.)

culturally. We have not been able to make fair tests of it as a cultivated plant, due to the difficulty of obtaining seed. Although it is common on our farm, it is very difficult to obtain even a small supply of seed. Several small quantities of seed have been sent to Hon. David Fairchild of the Foreign Seed and Plant Introduction Service of the Plant Industry Bureau. Possibly in the United States it will be easier to give it a trial.

As seen by the illustrations that accompany this article, this plant grows on hard, comparatively poor ground. The smaller, more bushy plant was found in the middle of the farm road on hard-packed ground. Nevertheless this plant is considered as one requiring fertile land, and is generally found on the better soils.

As to climate, Lavras is semi-tropical, our range of temperature being from 30° to 90° F., with an average of about 60°. But we saw this plant growing in the State of Paraná upon a mountain, where the cold is intense. How much frost it would stand we cannot say.

As to chemical analysis this plant reveals a very pleasant surprise. Its high protein content is very unusual. It is higher than that of most leguminous crops.

The analysis of the Secretary of Agriculture of Bello Horizonte is as follows:

	Per cent
Moisture	10.468
Ash	9.980
Protein	23.920
Fats	3.164
Cellulose	26.780
Non-nitrogenous ext.	25.688
Total	100.000

The analysis of the U. S. Department of Agriculture is as follows:

	Leaves, per cent	*Branches, per cent*
Moisture	8.36	7.04
Ether extract	2.29	0.59
Protein	20.88	14.06
Crude fiber	28.03	37.45

This plant is highly appreciated by cattle and horses and would probably be a feasible crop for hay if it could be cut and prepared before getting too woody.

There is another of this genus, *Solanum grandiflorum*, or *the fruit of wolf*, which has nearly 20% protein, which grows in much poorer land than the *Solanum bullatum*, and is eaten by the cattle in Brazil. This plant resembles a gigantic egg-plant. The tree has spines like the egg-plant and the fruits are similar also. The plant grows into a spreading tree about 8 to 10 feet high and will flourish on the poorest clay uplands. To us it does not appear to have much possibilities as an agricultural plant, but it seems to be worth more careful study and experiment to see what can be done with it. Lately we have had several inquiries about this plant from other parts of Brazil, and it is possible that soon something will be done with it in a practical way. We shall try and interest the government experiment stations in its cultivation and use.

An Old Issue Especially Wanted

Volume III, No. 1, the first quarterly issue of the American Breeders' Association (now the JOURNAL OF HEREDITY), is especially desired. Anyone having a copy for sale will please communicate. JOURNAL OF HEREDITY, Box 472, Eleventh Street Station, Washington, D. C.

THE RACIAL LIMITATION OF BOLSHEVISM

An Analysis of European History Shows That Nordic Countries Have Been Extremely Free from Periods of Anarchy

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IS THE Anglo-Saxon temper by nature averse to Bolshevism? Let us hope so. Do the facts of history help us to sustain such a belief? By and large, it would seem that they do. Bolshevism, while it is not anarchy in theory, leads to anarchy and to that extent is comparable with anarchistic periods in the past. These are all well known and recorded in our histories, and it is certainly not without interest and probably not without profitable suggestion to examine medieval and modern European history from a broad point of view and see if there is any notable predisposition towards or against anarchy that can be identified with racial differences. Race is, of course, neither identical with language nor with nationality. Yet anthropologists all recognize, as distinct from the Slavic, and from the Latin or Mediterranean, an Anglo-Teutonic or Nordic race. Scandinavia, northern Germany, Denmark, Holland, and Great Britain are to be considered as the present chief abiding places of this Nordic race—tall, blonde, dolichocephalic, enterprising, and masterful, with capacity for organization and practical thought.

These statements need not involve such controverted matters as the relative superiority of different races or questions of migration and mixture. At least the Russian peasant is different racially from the Dane or the Englishman of the same social class, and our question is whether the history of the chief Nordic countries is different from the history of Russia, the leading Slavic country in the amount of anarchistic tendency revealed.

No material has been collected for a wide comparison including all the Slavic nations, but, as far as Russia is concerned, it would seem that long periods of anarchy are nothing new, as the following instances prove. These are all taken directly from condensed estimates which were compiled for "The Influence of Monarchs,"[1] and are published in the appendix to that work to show the varying material conditions of fourteen European countries. They were not made with any idea of a study in proportionate anarchism.

In Russia, beginning with the minority of Ivan IV, 1538, there were nine years of intrigues, uprisings, and disorders. The Tartars harried the empire, and the state treasury was plundered. Treasons and conspiracies marked the brief period, April 13 to June 1, 1605. In 1606, for four years until 1610, general confusion again reigned. Russia was invaded by the Poles, and the Tartars plundered the border. In 1610 an interregnum commenced, with anarchy for two years, followed by the expulsion of the Poles. Civil disorder, however, continued until 1613. The public treasury was again plundered, as in the previous century. Again during the minority of Ivan and his brother, Peter the Great, 1682 to 1689, occurred another period of confusion and massacres. Russia during the eighteenth century was chiefly under the domination of Peter the Great and Catherine the Great and there were no notable periods of anarchy.

The above is not presented as a profound and accurate historical investigation into Russian anarchism. These

[1] Woods, Frederick Adams: "The Influence of Monarchs," New York, 1913, pp. 359–366.

periods were not, of course, entirely devoted to absolute lawlessness. To measure them intensively would be a long drawn-out labor. But these words and these descriptions are undoubtedly such as well describe the periods to which they are attached. They are merely the phrases used by standard historians and here reproduced just as found. No modifying or ameliorating clauses have been omitted.

Now, if we turn to a summary of the history of England during a similar period (c. 1461—c. 1801), we find that there are no periods in which the word anarchy is used by historians as applicable to a description of the condition of national affairs, or to a characterization of the spirit of the times. Earlier than this we do find an occasional period of anarchy, as, for instance, under the reign of Stephen (1135–1154), the brief uprising under Wat Tyler (1381), which lasted only two or three weeks, and Jack Cade's Rebellion, during the reign of Henry VI. But these are the only instances during the four centuries that followed the Norman Conquest. No materials are at hand to enable me to state just how much anarchy took place in Russia during these earlier times, but I imagine that there was much more than in England.

Scotland was long a backward country. Civil wars, border raids, plots, conspiracies, turmoil, and unsettled conditions are encountered frequently enough in the fifteenth and sixteenth centuries, but all this is different from anarchy, and I do not find the word anarchy used at all by historians as applicable to early Scottish history. It seems rather that they always kept to group or clan formation. The organization of the whole was broken into parts, but the organizations remained and the lower orders always followed their leaders. The history of Scotland shows that it was not merely because Russia was a backward country that she indulged in so much anarchy.

Sweden, a good example of a Nordic country, shows no periods of anarchy during these centuries.[2] General discontent and suffering, disorder, religious and personal warfare, misfortune and poverty, lethargy, and even national humiliation, are some of the descriptive phrases picturing the dark aspects of Sweden's history, which occurred from time to time, but never the word anarchy.

Denmark in its history is nearly free from anything approaching extreme lawlessness. We find only during the interregnum, 1533–1534, civil wars, violences, and cruelties. The same may be said for Holland. Party struggles, persecutions, financial exhaustion were not unknown, but except for the brief period, 1747–1751, characterized by internal commotion and some uprisings, there were no lapses on the part of the Dutch from the maintenance of organized government.

Also Prussia has scarcely ever before known the meaning of being without a recognized and ordered government. During most of her history it has been her fate to be under strong monarchical leadership. There were only two distinctly weak Hohenzollerns from 1415 to the death of Frederick the Great in 1786. Under George William (1619–1640), during the Thirty Years' War, the nation was brought to bankruptcy, political dissolution, and internal lawlessness.

In this question of anarchistic tendencies as shown in history, France presents an intermediate position between Slavic Russia and the strictly Nordic countries just described. The anarchy of the French Revolution is, of course, enough in itself to place France below the Nordic countries in a record for good behavior on law-abiding grounds. There were not many periods of anarchy earlier than this unless we go back to ages earlier than are here considered. Subsequent to the middle of the fifteenth century there was at least one time during the reign of Henry III when bands of lawless adventurers overran the land.

Thus a survey of Anglo-Teutonic history from the middle of the fifteenth century to the beginning of the nineteenth brings out the fact that Nordic races have not been appealed to by an-

[2] 1525–1792, *ibid.*, pp. 354–358.

archistic temptations. The racial elements in the make-up of Russia are mainly Slavic. They are of the Alpine or brachycephalic type. The true Russians constitute nearly three-fourths of the population of Russia, the rest are chiefly Letto-Lithuanians, Poles, Jews, Finns, Turco-Tartars, and Mongols. They have indulged in much anarchy in the past. Historical evidence strongly suggests that there is something inherent in the temperament of the Slav causing him to yield much more easily than his Nordic neighbor to the temptations of mob violence. Let us hope that now is another time when nature will assert itself as stronger than nurture and that Bolshevism will find itself delimited on the Anglo-Saxon frontiers.

Army Tests Reveal the Vast Differences in Mankind.

The comparison of negro with white recruits reveals markedly lower mental ratings for the former. A further significant difference based on geographic classification has been noted in that the northern negroes are mentally much superior to the southern.

In a certain training camp 221 inapt soldiers, belonging to a negro regiment of pioneer infantry, were referred by their commanding officer for special psychological examination. Nearly one-half (109) of these men were found to have mental ages of seven years or less. *The army nevertheless had been attempting to train these men for military service.*

In another instance some 306 soldiers from organizations about to be sent overseas were designated by their commanding officers as unfit for foreign service. They were referred for psychological examination with the result that 90% were discovered to be ten years or less in mental age, and 80% nine years or less.

The utilization of methods of mental testing by the army has at once increased military efficiency by the improved utilization of brain power and demonstrated the applicability of the group method of measuring intelligence to educational and industrial needs. The army methods, although not adapted to the usual educational or industrial requirements, can readily be modified or used as a basis for the development of similar procedures.

There are abundant indications that the future will witness the rapid development of varied methods for improving scientific placement and vocational guidance. It is highly probable that grading in the public schools, in colleges and professional schools will shortly be based in part upon measurement of mental ability instead of exclusively on measurements of acquisition.—*Science, March* 14, 1919.

INHERITANCE OF CONTINUOUS AND DISCONTINUOUS VARIATIONS

DR. F. B. SUMNER has been making some studies of inheritance in deer-mice. Writing on the question of discontinuous variation, his conclusions do not support the views of Bateson and DeVries.

"The dorsal tail-stripe is entirely lacking in a certain strain of my mutants. This stripeless condition is recessive to the striped one. In crosses with normal mice, the stripe appears in its full size and intensity. Nevertheless, the stripe itself was shown in the preceding pages to vary from race to race and from one individual to another. *And these variations, both racial and individual, were found to be hereditary.*

"The case, of course, is parallel to that of Castle's hooded rats. Since 'hoodedness' is recessive to 'self-color' and reappears in one fourth of the F_2 generation. Castle argues that it is dependent upon a single unit factor. Nevertheless, this factor itself presents hereditary variations in 'potency,' since it can be modified indefinitely by selection. The Mendelian counter-argument is that 'hoodedness' behaves as a unit character in certain crosses merely because there is some one factor without which it cannot manifest itself *at all.* The variability in its *degree of manifestation* is due to the fact that the hooded pattern is modified by the action of a number of independent cumulative factors. The argument seems a bit scholastic, but we must admit that it is logical and consistent." Dr. Sumner states his own conclusions in part as follows.

"All of these differences, structural and pigmental, are found to be differences of degree, revealed through a comparison of mean or modal conditions rather than of individual animals. In comparing the less divergent of these races with one another, the frequency polygons for any given character overlap broadly.

"These subspecific differences, and even the minor differences which distinguish one narrowly localized sub-race from the parent form, are found to be hereditary, as evidenced by their persistence when environmental conditions are interchanged.

"The gradations in certain of these characters by which individuals of the same race differ from one another are found to be strongly hereditary.

"Hybrids between even the most divergent of these four races are predominantly intermediate in character, both in the F_1 and the F_2 generations. In both of these generations a wide range of variability is exhibited, which, however, is little if any greater in the F_2 than in the F_1.

"In contrast to the sensibly continuous variation and sensibly blended inheritance shown in respect to these subspecific characters, is the behavior of certain 'mutations.' Here we meet with typical discontinuous variation, and inheritance of the strictly alternative or Mendelian type. It is insisted that the burden of proof rests upon those who contend that these two types of variation and inheritance are reducible to a single category—that of discontinuity. Anything like a proof of this contention appears to be thus far lacking."[1]

[1] Sumner, F. B., Continuous and Discontinuous Variations and Their Inheritance in Peromyscus—III. In *American Naturalist*, vol. 52, August-September, 1918.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, July 15, 1919.

A HYBRID BETWEEN WHEAT AND RYE

The two parents are shown at the extreme right and extreme left. The first and second generation from the cross are shown in the center, F_1 and F_2. (Frontispiece.)

FERTILE WHEAT-RYE HYBRIDS[1]

Crosses Between Wheat and Rye Are Usually Sterile—A Fertile Cross May Have the Good Qualities of Wheat and the Hardiness of Rye

H. H. Love and W. T. Craig

(In Coöperation with the Office of Cereal Investigations, U. S. Department of Agriculture)

At various times crosses have been made between wheat and rye. One of the earliest to report was Wilson (1) who was followed by Carman (2), Rimpau (3) and others, namely, Signa (4), Schliephacke (5), Miczynski (6), Nakao (7), and Tschermak (8). The result of most of the crosses was that the hybrid plant was sterile. Only Miczynski, Carman and Rimpau obtained fertile hybrids. Later we have the work of Jesenko (9), Leighty (10) and McFadden (11). The latter reports the result of a wheat-rye cross which was sterile. Leighty reviews the work of Carman and later gives some of his own work where he produced wheat-rye hybrids artificially and also found some natural hybrids between wheat and rye.

Jesenko reports upon what seemed a fertile wheat-rye hybrid but, as a result of further investigation, concluded that what he supposed was a fertile hybrid was really the result of a backcross between the F_1 and wheat. He also believed that the fertile hybrids obtained by Rimpau and Miczynski were the result of backcrossing with wheat and not the result of self-fertilization. Jesenko backcrossed very many F_1 flowers with both wheat and rye. When he used wheat he obtained about three seed per thousand flowers pollinated, and with rye he obtained only one seed from 4,800 flowers pollinated. When the F_1 was backcrossed with wheat the resulting F_2 plants were very similar to wheat, and the result when rye was used was a plant very similar to rye.

Jesenko suggests that it is possible that in the egg cells the amount of wheat and rye plasm is not equally distributed but that sometimes more wheat and, again, more rye plasm is present. Then, when a pollen grain from a wheat plant would fertilize an egg cell with little rye plasm and nearly all wheat, a plant similar to wheat would be obtained. This plant would be fertile. As the rye plasm is increased, in the egg cells the plant developing will be less wheat-like and less fertile. This would continue until complete sterility would be obtained. The reverse would be true if a pollen grain from rye would fertilize an egg cell containing more rye plasm than wheat. The plant would be fertile and more like rye. As the rye plasm decreases and the wheat plasm increases the resulting plant would look less like rye and would be less fertile until complete sterility would be reached.

A SUCCESSFUL CROSS

A number of crosses between wheat and rye have been made by the authors. Most of these have been sterile in F_1 and no attempts were made to cross them back with wheat or rye. So far as the characters of these hybrids are concerned, they agree with the results usually obtained when this cross is made, in that the hybrid is intermediate in many respects. Two hybrids between wheat and rye have been fertile, and it is planned to describe here briefly the results obtained, so far, from one of these crosses.

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[1]Paper No. 76, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION

The heads are more like wheat than they are like rye, yet in some respects they indicate their hybrid origin. (Fig. 1.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION

The kernels showed some variation and seemed from their shapes to show differences that are not common among wheat hybrids. Most of these kernel types are shown in Nos. 11 and 12. (Fig. 2.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION. (Fig. 3.)

HEADS OF THE DIFFERENT PLANTS OF THE F_4 GENERATION. (Fig. 4.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_1 GENERATION. (Fig. 5.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION. (Fig. 6.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION. (Fig. 7.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION

Head No. 39 is much like rye in regard to the awn development and ciliated glumes. (Fig. 8.)

HEADS FROM THE DIFFERENT PLANTS OF THE F_4 GENERATION

There is considerable variation as to the degree of sterility found. Certain ones are fully fertile while others are nearly sterile. Nos. 43 and 47 are examples of the nearly sterile. (Fig. 9.)

The variety Dawson's Golden Chaff was crossed with common rye and from this cross one plant was obtained. This F_1 plant gave every indication that it was a wheat-rye hybrid. It had a few awns develop particularly at the tip of the head. The glumes were brown and intermediate between those of wheat and rye. They were keeled more like rye and ciliate. There was only a slight pubescence of the peduncle. While in some wheat-rye hybrids this is very pronounced, other hybrids have been obtained which are not at all pubescent.

This hybrid plant was not completely fertile but one seed was obtained which produced a plant in the following generation. The parent heads and a head from each of the F_1 and F_2 plants are shown in frontispiece. The F_2 head was much like F_1, but more awns developed. It showed in many ways its rye parentage. The glumes were sharply keeled and ciliate. More awns developed than in the case of the F_1 type although this plant was not as fully awned as rye. The peduncle was not pubescent at all. Only one viable seed was obtained from this plant. This seed produced a healthy plant the following generation. This plant in appearance was more wheat-like than either the F_1 or F_2 and produced many seed. It did not show its hybrid nature to any great extent so far as the head characters are concerned.

A number of seed were sown from this plant and an F_4 generation was grown. The plants resulting from these seed were very variable so far as awns, color of chaff and color of kernel are concerned. The color of chaff, beards and color of kernel seemed to all follow a simple Medelian ratio of 3:1, thus indicating that segregation in wheat-rye hybrids occurs the same as when two varieties of wheat are crossed. It should be noted that the color of kernel of the wheat parent was white, so that any color must have come from the rye. The heads are all more like wheat than they are like rye, yet in some respects they indicate their hybrid origin. A number of these heads are shown in Figs. 1-2, Nos. 2–10. Head No. 39 was much like rye in regard to the awn development and ciliated glumes. It is evident that there is considerable variation as to the degree of sterility found. Certain ones are fully fertile while others are nearly sterile, for example Nos. 43 and 47 (Fig. 9).

The kernels showed some variation and seemed from their shapes to show differences that are not common among wheat hybrids. Most of these kernel types are shown in Figs. 2 and 3, Nos. 11 and 12. In regard to the general appearance of the plants many of them showed their hybrid nature by the color of the stems and certain likenesses to rye. This was so apparent that a visitor on looking over the cultures in the greenhouse remarked on their rye-like nature without knowing what the series was. None of the plants had the pubescent peduncle as the F_1 did, but as this pubescence was lacking in F_2 these F_4 plants would not be expected to possess this pubescence. Since known F_1 wheat-rye hybrids occur without the pubescence it is not a certain criterion of a wheat-rye hybrid that it was formerly thought to be.

Some of these F_4 families have been carried further and they continue to produce plants that, so far as the heads are concerned, are more wheat-like in their nature, yet so far as the plant is concerned show some resemblance to rye.

WINTER HARDINESS

Some of these hybrids are now being tested under field conditions to determine whether they may have inherited any of the winter hardiness of rye. If it is possible to obtain such a plant with the good qualities of wheat, one would be able to sow later than is now done and still obtain a good stand. The importance of this is self-evident and would mean much to wheat growing areas where winter killing is severe.

From these results it seems without doubt that we have a fertile wheat-rye hybrid and that the seed which developed on the F_1 plant was the result of self-fertilization and not a result of a backcrossing with wheat or rye. If

KERNELS OF DIFFERENT PLANTS FROM THE F_4 GENERATION. (Fig. 10.)

KERNELS OF DIFFERENT PLANTS FROM THE F_4 GENERATION. (Fig. 11.)

this had been so, and accepting Jesenko's conclusion, the plant would either have been more wheat-like if crossed with wheat, or more rye-like if crossed with rye. The plant was more like the F_1 than either wheat or rye and was partially fertile, and the plants produced from it wheat-like in appearance, yet showing some relationship to rye.

The fact that there is some partial sterility among the later plants and that some of the plant characteristics are like rye is further evidence that we have a fertile hybrid between wheat and rye. It may be possible to find certain wheat varieties that may produce fertile wheat-rye hybrids. The results already obtained would lead to that conclusion.

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A Freak Papaw (Carica Papaya)

The Editor,
Journal of Heredity.
Dear Sir:

As generally found, the papaw fruit is green in color when immature, and, though in some cases it continues so, even when fit for eating, it often shows an orange coloration, running down the fruit in bands. Occasionally the entire fruit turns orange yellow—generally when left to ripen on the tree.

In the village of Dippittigala, about 6 miles from the provincial town of Ratnapura, in Ceylon, the writer observed a clump of papaw trees of a strange appearance. All the fruits, from the smallest to the largest, were of a sulphur yellow color, and the leaves wore a marbled appearance in which the same color predominated. The smaller fruits were so light in color that they were almost white. On enquiry, the fact was elicited from one of the prominent residents in the neighborhood that the seed from ripe fruits of this strange variety gave rise to progeny true to type. Specimens were secured and brought to Peradeniya, where plants raised from seed were found to produce the ordinary green variety.

Recently the writer visited the same village and made further enquiries, and was able to verify the fact that while some of the seed from the trees in question bred true, others did not. The appearance of the trees at Dippittigala suggested the name of "Albino Papaw." The question arises—is this a case of Albinism?—C. Drieberg, *Superintendent of School Gardens, Peradeniyd, Ceylon.*

POPULATION SCHEDULE FOR THE CENSUS OF 1920

Harry H. Laughlin

Eugenics Record Office, Cold Spring Harbor, Long Island, N. Y.

The Fourteenth decennial census of the United States will be taken as of January 1, 1920. The mere counting of the people has long ceased to constitute the chief activity and purpose of the federal census. Formerly the census organization was made and dissolved for each decennial canvass and tabulation, but by the act of March 6, 1902, Congress provided for a permanent Bureau of the Census which was created in the Department of the Interior. Later, when the Department of Commerce and Labor was organized, the Bureau of the Census was transferred thither. At present this Bureau is part of the Department of Commerce. Thus the impending decennial census will be the second taken under the permanent organization. The intercensal years are occupied by analyses and publication of decennial census material, and in making and publishing the results of many special surveys.

THE POPULATION SCHEDULE

Section 8 of the Act of March 3, 1919 (an Act to provide for the fourteenth and subsequent decennial censuses) reads: "Sec. 8. That the Fourteenth Census shall be restricted to inquiries relating to population, to agriculture, to manufactures, to forestry and forest products, and to mines and quarries. The schedules relating to population shall include for each inhabitant the name, place of abode, relationship to head of family, color, sex, age, conjugal condition, place of birth, place of birth of parents, nationality or mother tongue of all persons born in foreign countries, nationality or mother tongue of parents of foreign birth, number of years in the United States, citizenship, occupation, whether or not employer or employee, whether or not engaged in agriculture, school attendance, literacy, tenure of home and the encumbrance thereon, and the name and address of each blind or deaf and dumb person." . . .

Then follow the specifications for the schedules relating to agriculture, to manufactures, to forestry and forestry products, and to mines and quarries, each set of which is equally extensive with that for population. The value to the nation of the summarized and digested information secured by these schedules is of course very great.

EUGENISTS AND GENEALOGISTS DESIRE AMENDMENT TO POPULATION SCHEDULE

In 1916, Alexander Graham Bell, Chairman of the Board of Scientific Directors of the Eugenics Record Office, proposed a resolution which was unanimously adopted by this body, to the effect that it would be highly desirable in the interests of American family history studies if to the census schedule there were added two items: first, "name of the father of the person enumerated;" and second, "full maiden name of the mother of the person enumerated." The Eugenics Research Association, through its Executive Committee, in following up this purpose, presented on February 21, 1919, the following memorial to the Director of the Census:

"To the Hon. Samuel L. Rogers, Director of the Census of the United States, A Memorial:

"In the interest of race betterment in the United States, the Eugenics Re-

search Association, by formal vote of its Executive Committee, respectfully memorializes the honorable Director of the Census to provide in the forthcoming general enumeration of the Census of 1920, and in all future censuses, for recording the *name of the father and the maiden name of the mother of every person enumerated.* This could be done by adding to the enumeration sheet for the Census of 1910, between columns 11 and 12, two 1½-inch columns, the pair of columns headed *Ancestry;* the first column of the pair sub-headed *Full Name of Father of this Person;* the second column of the pair sub-headed *Full Maiden Name of Mother of this Person.*

"We respectfully set forth the very great value in this and in future censuses of the facts which would thus be secured:

"1. The family ties would be established and thus all census enumeration records would become available for genealogical and family pedigree-studies.

"2. Persons of the same name would be distinguished by connecting each other with the name of his own father.

"3. The position in the family tree of married men and women would be established.

"4. The relationship of unmarried women in the household would be established.

"5. Family records would be preserved intact, despite the change of surname and of surname spelling.

"6. If used in a series of censuses, this one item would enable the student of American families to construct, from the census records alone, the family trees of all American families. Thus by this relatively simple correction, the United States Federal Census reports would constitute the greatest and most valuable genealogical source in the world.

"This proposition was first urged by Alexander Graham Bell at the annual meeting of the Board of Scientific Directors of the Eugenic's Record Office in 1916, and was unanimously adopted by this Board, which at that time consisted of: Alexander Graham Bell, Chairman; William H. Welch, Vice-Chairman; Lewellys F. Barker; Irving Fisher; T. H. Morgan; and Charles B. Davenport, Secretary and Resident Director. The experience of Dr. Bell in practical census work makes his opinion on this particular matter especially worthy of your careful consideration.

"Respectfully submitted,

———

"February 21, 1919."

Besides the arguments enumerated in this memorial in favor of supplementing the census records by the addition of "the name of the father and the full maiden name of the mother of every person enumerated," the following points are presented:

1. By the use of population-records containing these facts, the individual could be located from census to census and from generation to generation. Thus not only could the statistician secure from the census returns mass data descriptive of general demographic conditions, but also he could trace individual and family fortunes. This would enable the analyst to measure the personal "overturn" in population, wealth, occupation and residence. Such investigations would be of the greatest social and political value.

2. Except for persons who are born and who die within the same intercensal period, the entire genealogical trees of all families of the American population, together with many facts of biography and personality, beginning with the oldest generation living at the inauguration of the system, could be constructed and permanently maintained.

3. Fragmentary data concerning ancestors would be sufficient clues to enable the investigator, by the use of the records asked for, authentically to restore a family tree.

4. The American people are learning to treat family-history archives more as pedigree-records for use in tracing the descent of natural traits, than solely as genealogical studies whose chief motive is superficial social distinction. The desired census data would therefore be put to a very useful purpose.

5. The records of parentage as given by the census would be of great legal value in supplementing local records

in cases involving inheritance and property, indeed in many instances the census records would constitute the only documentary evidence of parentage.

To summarize: Present census methods give statistical pictures of the population, but do not trace personal or family fortunes. The addition of only two items to the population schedule—"the name of the father, and the full maiden name of the mother," would permit the analysis of census returns on the personal and family-history basis. The fortunes of the nation are indissolubly united with those of the individual, and since the rate and extent of "overturn" in personal fortune is an index to the quality of national growth, the value of the proposed analyses would repay many times the relatively slight additional cost and effort involved in adding the two desired items to the population schedule.

Six Hundred Twins Already Discovered

Twins Which Were Separated in Babyhood Especially Sought

The American Genetic Association through the generous coöperation of the press has been placed in communication with over six hundred twins and several hundred of them have sent excellent photographs illustrating in many cases most remarkable similarity. It is particularly important in the researches that are being carried out that such identical twins as have lived in entirely different environments be found and further publicity leading to the discovery of pairs of identical twins, the individuals of which have lived in different countries and have been taught from childhood different languages is desired. All communications should be directed to the American Genetic Association, Washington, D. C.

Any twin coöperating with the Association will be supplied with any special articles published relating to these researches.

The Beginnings of the Nervous System

THE ELEMENTARY NERVOUS SYSTEM, by G. H. Parker, Sc.D., Professor of Zoölogy, Harvard University. Pp. 229 53, illustrations. Price, $2.50 net. Philadelphia and London; J. B. Lippincott Co. (Monographs on Experimental Biology), 1919.

Confining himself mainly to such simple forms of life as sponges, jellyfishes and hydroids, Dr. Parker has outlined in detail the nature of the elementary nervous system, particularly with a view to showing its limitations. His point of view is described in his preface: "The dependence of human affairs upon the nervous system of man is so absolute that it was inevitable, as soon as this relation was understood, that the activities of the simpler animals should be interpreted as though these creatures were miniature human beings. That such interpretation was carried far beyond its legitimate bounds, even by the scientifically trained, is now admitted on almost all sides. That these bounds are vastly more restricted than has usually been supposed is certain. An approach to a clearer understanding of what they are is assured through the application of experimental and quantitative methods to the questions concerned rather than by a continuation of the older more purely observational procedure."

Why the Babies Die

INFANT MORTALITY: Results of a field study in Brockton, Mass., based on births for one year, by Mary V. Dempsey. U. S. Dept. of Labor, Children's Bureau Publication No. 37. Pp. 82. Washington, D. C., 1919.

Brockton is a center of shoe manufacture, and a prosperous New England town. The Children's Bureau surveyed it to find why the infant mortality rate was so low (96.7). It ascertained some commonplace things, and some that were unexpected, as that the mortality among babies of foreign-born mothers was lower than among babies whose mothers were native Americans. Like most of the studies the Children's Bureau has made on infant mortality, this one is statistically inadequate and misleading. The conclusion is that Brockton's infant mortality rate is not so low as it ought to be, considering the high wages paid to shoe-workers and the good municipal sanitation. The insistence on economic factors, and the failure to deal with biologic factors that might affect infant mortality, render the study of little real value.

The Inheritance of Blindness

THE BLIND, their condition and the work being done for them in the United States, by Harry Best, Ph.D. Pp. 763. New York: The Macmillan Co., 1919.

Heredity plays an unimportant part in causing blindness, according to Dr. Best. His chapter on heredity, like many other chapters of the book, is a compilation marked by little grasp of the subject, but he concludes that possibly not more than 10% of the blind owe their infirmity to inheritance. Heredity causes blindness, apparently, in a dozen or more different ways, of which cataract is the most frequent. The blind do not tend to marry in such large proportion as the normal members of the population. "The likelihood of blind offspring is not necessarily greater when both parents are blind than when one is blind and the other sighted," except in cases of consanguineous marriage, of course. From Dr. Best's citations it would seem that there are considerable data available for a study of the inheritance of blindness, but he himself has added nothing to the subject.

A Compilation on Subnormality

PROBLEMS OF SUBNORMALITY, by J. E. Wallace Wallin, Director of the Psycho-Educational Clinic, Board of Education, St. Louis; with an introduction by John W. Withers, Ph.D., Superintendent of Public Schools in the City of St. Louis. Pp. 485. Yonkers-on-Hudson, N. Y.; World Book Co., 1917.

Dr. Wallin has diligently brought together an immense amount of miscellaneous material relating in a general way to the problems of subnormal intelligence. He considers "The Changing Attitude towards the Subnormal," asks "Who is Feebleminded?", outlines his views on the proper education of feebleminded and backward children, inserts a paper an epilepsy, summarizes the present state provisions for defective children, and concludes with 46 pages on "The Hygiene of Eugenic Generation." This last chapter is marked by such a confusion between eugenics and euthenics, and such an uncritical handling of facts and authorities, that it has little value. Throughout the book Dr. Wallin wisely insists on proper use and standardization of mental tests, and condemns attempts to include too large a proportion of the population in the category of feebleminded. The book is useful as a source of citations and compendium of facts gathered from the literature, but the reader in using it will have to apply the critical selection to data which Dr. Wallin himself has not applied.

PORTRAITS OF EARLY AMERICANS[1]

Recent Publication by Charles K. Bolton Shows Intermediate Type in the Evolution of the Nordic Face—Eyes and Nose Show the Most Interesting Changes

FREDERICK ADAMS WOODS

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FOR four or five hundred years artists have been making graphic records of the human face. Yet this historical, anthropological, and often beautiful material has been but little utilized in the study of evolution. That it can be utilized to a very great extent can scarcely admit of doubt. Racial types are often no more clearly marked in the faces of the living than in the portraits of the dead. Eye-color, hair-color, the shape of the bones of the head, and more particularly the bones of the face, the modeling and even the expression of the mouth, are all significant and vary in diverse races, families, and social classes. Character and intelligence are usually clearly written in physiognomy. It only remains for the intuitive perception of the expert to be supplanted by measurements and inductive analysis, and the human face, containing the most vital, the most varying, the most revealing of all anthropological data, will be promoted to its position of importance in classifying mankind.

How do we recognize an old friend or anticipate a new one? How do we determine a person's probable attractiveness? How do we quickly differentiate the special racial subdivisions of mankind? We do not measure the shapes of their heads. We look them squarely in the face. And, undoubtedly very limited portions of the face suffice, —notably the small region around the mouth and nostrils and certain indications about the eyes. For instance, the Mongolian eye is characteristic, although occasionally found in other races. The Semitic nostril and upper lip are, in that race, so ancient and universal that they appear with equal constancy and obviousness in the earliest profile drawings in Babylonian days.

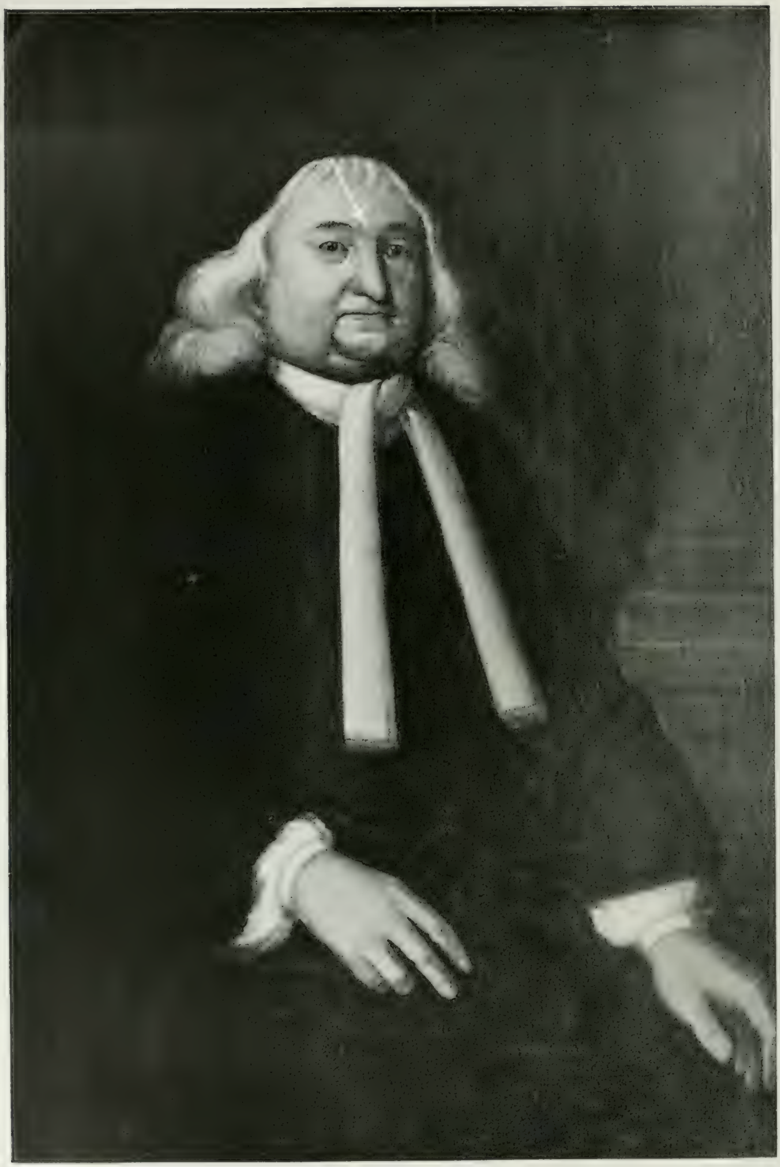
DEARTH OF ANATOMICAL MATERIAL

Evidences of anatomical evolution are not lacking if one goes back to prehistoric times. The Neanderthal and other very early skulls, human or semi-human, are small in cranial capacity and primitive in shape. Anthropologists have found but little evidence of recent human evolution—that is, within historic time. We do judge from the sizes of suits of armor that men are somewhat larger than they were a few hundred years ago, but increased body size may not mean intellectual evolution. The reason why anatomists have failed to find visible evidence of recent evolution is because they have attended to every part of the body except that one external feature which is most indicative of character and intelligence. If there be a real, recent mental evolution, and if anatomists for centuries had been studying the internal structure of the brain after the methods of modern technique—mapping brain regions and counting brain cells—they would have found such evolution. But, naturally, the older anatomists kept no such records; and now, after the once living gray

[1] Review and supplementary research based upon "The Founders: Portraits of Persons Born Abroad Who Came to the Colonies in North America before the Year 1701," with an introduction, biographical outlines, and comments on the portraits, by Charles Knowles Bolton In 2 volumes. *The Boston Athenaeum*, 1919.

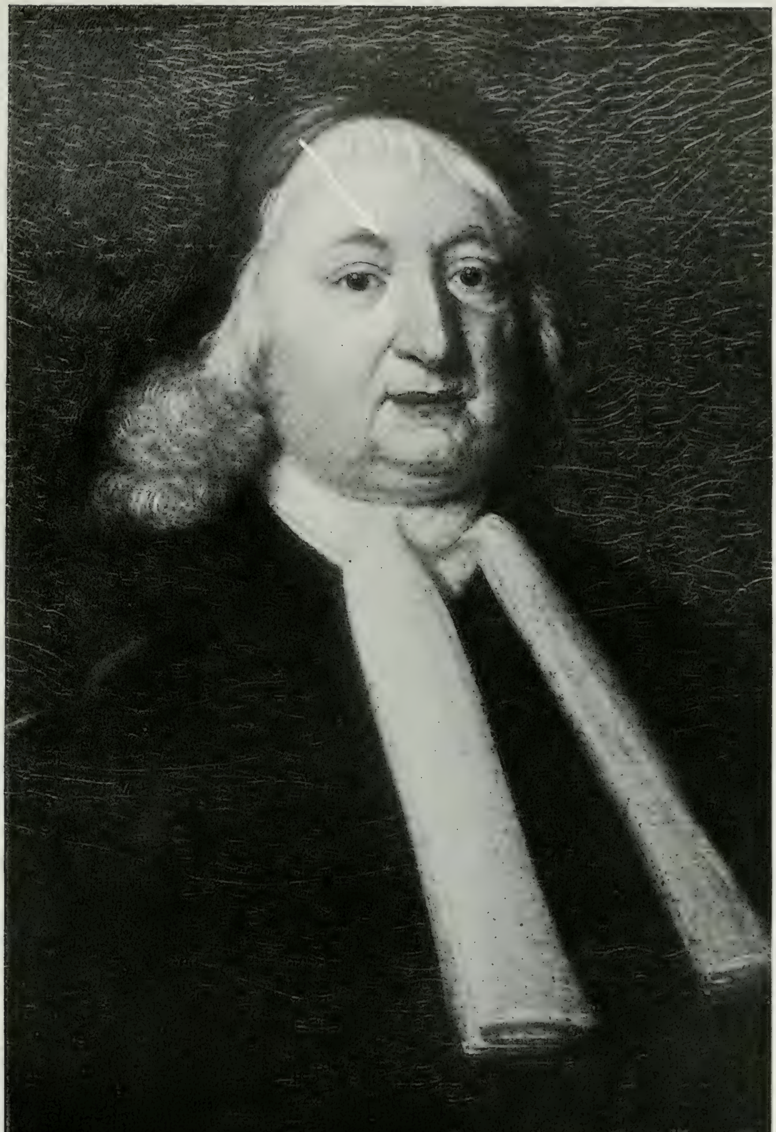
REV. SIMON BRADSTREET

The arrow calls attention to the eyebrow, which is very high above the eye. This is typical in the early portraits of English people but not in the early portraits of Italians. Also, the nose is broad at the top and the eyes are far apart. The arrow has been added by the reviewer. (Fig. 13.)



SAMUEL SEWALL, 1652-1730

The arrow calls attention to the broad nose and high upper eyelid. Both were common in the sixteenth century. They were not uncommon in the seventeenth and eighteenth centuries. They are rare today but can be found occasionally. (Fig. 14.)



STEPHEN SEWALL, 1657-1725

Brother of Samuel Sewall (Fig. 14). The family resemblance is striking. The arrow calls attention to the high eyelid very similar to that of his brother. Note the great vertical distance between the point of the arrow and the center of the eyeball. (Fig. 15).

matter has gone forever, the one anatomical record most likely to reveal the inner brain is the face itself, which may be regarded in more ways than one as the next thing to it.

THE USE OF PORTRAITS

In order to make satisfactory studies of ancient portraits, good photographic copies are needed, and many specimens must be brought together for comparison and analysis. Here we are in an advantageous position over our forefathers, who did not have photography to make possible a large collection of good copies. Also, to make a fair comparison, a collection of complete portraits of some one race or historical group is desirable.

In the collected photographs of portraits in famous national galleries we, to a certain extent, have reasonable completeness, though all portraits must be classified according to period and nationality. The work on Early Portraits in the National Portrait Gallery; London, (1400–1500) and Volume II (1600–1700) form suitable collections for studies of measurement and analysis, since all or nearly all belong to the strictly English breed.

PORTRAITS OF THE FOUNDERS

Recently Charles K. Bolton, Librarian of the Boston Athenaeum, has brought together and published a very important collection of photogravures of all the portraits obtainable of the founders of the colonies in North America who came before 1701. Such a collection is valuable and satisfying on account of its completeness. It is not likely that more than a very few portraits, not in the collection, will ever be unearthed. As the author truly says:

"The value of the pictures here reproduced will increase with the years, for they represent men and women who came together from the countries of Europe to found colonies which have been federated into a great republic. Inevitably a few portraits have been overlooked, and when these have been added we shall have between the covers of one work all the faces that we shall ever see from that historic past. The portraits are of value for their evidence of dress, armor, and fashion; but there is a still more fundamental significance in these faces as a group, for they show the type of the immigrant of the seventeenth century—austere, adventurous, and resolute."

Mr. Bolton in his Introduction accepts my conclusion, reached some years ago from a study of Italian, French, Flemish and English portraiture, that the face of the Nordic has actually changed since the beginning of the sixteenth century.[2] The greatest change is in the region of the eyes. The eyes are now more often near together than formerly. This means that the breadth at the top of the nose which is generally associated with eyes wide apart, is frequent in early portraits and disappears with the course of time. This unusual breadth at the top of the nose is indicated by the arrows in Figs. 13–16. The eyes in these portraits are far apart.

The second point of distinction is the distance between the eyebrow and the pupil of the eye itself, that is, the eyebrow in the early portraits is often high above the eye, the upper eyelid presenting a flat surface. The eye is not set in under the orbital arch as is usual today. The cheek-bones are somewhat less prominent now than formerly, but otherwise the face has changed but little. Figs. 13, 14, and 15 show the eyebrow very high above the eye, as is indicated at the points of the arrows.

NOT AN ARTISTIC MANNERISM

Portraits are not, like photographs, mechanical records. Consequently the personal equations of the different artists must be taken into consideration. There is, for instance, the well-recognized "Sir Peter Lely eye," and one is inclined to think that much of this change in eye-form is due to an improvement in the art of painting. But this will not stand the test of comparative analysis. While most of the earliest portraits are crude in their primitiveness (those prior to Holbein, for instance), the portraits by Holbein

[2] Problems in Eugenics. London, 1912, p. 251.

A SIXTEENTH CENTURY NOSE

The nose, rough in outline and broad at the top, was common to Nordics in the sixteenth century, and by no means rare in the seventeenth. Here the upper eyelid is more like a modern, but the eye is by no means as deep set as is usual today. The portrait is that of Nathaniel Byfield, 1653-1733. (Fig. 16.)

himself, who was doubtless an accurate realist, are replete with this early or mongolioid type. Not all of the Holbeins show this characteristic. Some are always in a median or doubtful grade between the early and the late types, but the number of distinctly modern "eye-nose regions" is always enumerable, and it is this increase in proportionate numbers through the centuries, without regard to the amount of mastery in the art of portraiture, that makes it improbable that the change represents anything less than a real evolution in the bony structure of the face. In other words the archaic type of eye is as common in the finished and accurate work of any given period as it is in the cruder work.

The faces of the upper classes among the Nordic people have approached toward the Mediterranean or even toward the Greek type. Early Greek sculpture shows this mongolioid feature, but it is not at all certain that this was merely because it was primitive art. Primitive Italian art does not show the early type,[3] except nearly always when the Virgin is depicted. She is also represented with very high eyebrows and eyes far apart in most of the later paintings of the sixteenth century. The Mediterranean peoples, including the Italians of the Renaissance, never, except in a small percentage of instances, exhibited the ancient northern type of eye and nose.

Among modern Nordics the ancient type still persists among perhaps 10 to 15% of the whole population.[4] Many accurate measurements have been made from photographs of English, French, Flemish, and Italian portraits.

In the case of Mr. Bolton's fine collection of early American likenesses, I have merely gone through the two volumes and placed as nearly as possible each in one of three grades. There are, out of 113 authentic portraits (sufficiently clear and available for comparison), about 37 of the ancient type, 37 doubtful or intermediate, and 39 modern, or low in eyebrow, with eye well under the orbital arch. The earliest authentic portraits of the Nordic upper classes, or well-to-do upper middle classes, *i. e.*, persons who were able to have their portraits painted, show more than 50% of the early type; the same class, roughly speaking, in America today shows only 10 or 15% of this form. The faces of the seventeenth and early eighteenth century as revealed in Mr. Bolton's collection show 32.8% Thus the middle period fits in, as it should, part way between the two.

CHARACTERISTICS OF THE PURITANS

The "Portraits of the Founders" forms not only a magnificent and thorough historical collection, analyzing the authenticity and history of each picture, but it also, in a novel way, reveals the characteristics of the Puritans and the Cavaliers. Rev. Simon Bradstreet has, I should say, a very pleasant face (Fig. 13). It is fully in accordance with his reputed character. Such agreeable faces are, we must admit, rare among the portraits of early New Englanders. Sir Richard Saltonstall, John Leverett, Mabel Harlakenden, Thomas Amory, Rev. Hanserd Knollys, Richard Middlecott, James Bowdoin, Margery Pepperrell, Sir Henry Vane, Penelope Winslow, Mary (Luttrell) Winthrop and Stephen Winthrop present few of the puritanical aspects of countenance. These it may be noticed were not strictly typical Puritans, and many of them were persons of gentle blood.

The relation of history and portraiture to biology and racial heredity is not unappreciated by Mr. Bolton, who says:

"We are perhaps too ready to deal

[3] See for instance School of Cimabue, Chiesa Inferiore di S. Francesco Assisi, and Giotto, Marriage of St. Francis to Poverty, Allegory of Chastity, etc. Here there are many faces all modern with the exception of the Virgin.

[4] The first 337 portraits in Vol. xv of the National Cyclopedia (N. Y., 1916) show, as regards height of eyebrow, 39 of the ancient type, 67 doubtful, and 231 modern.

A MORE MODERN TYPE

Here the eyes are more deeply set under the eyebrows and the nose is narrow at the top. She was born in 1674, wife of Isaac Norris, Mayor of Philadelphia in 1724. Her ancestry was gentle and in part noble and royal. Many of her descendants are living today. (Fig. 17.)

with these ancestors capriciously, either holding up our own standards to their life histories and marking the contrasts, or, on the other hand, associating their undoubted weaknesses with the age in which they lived and treating leniently frailties that should be condemned in any age. They did, many of them, come here to escape episcopacy, not to grant liberty of conscience to others. Most were bigoted in a day when the logic of convictions made men intolerant. The Puritans were the liberals of their time, but they were only a shade more tolerant than the conservative Roman Catholics; while none of them, unless we except possibly the Episcopalians, with somewhat adjustable convictions, had any affection for radicals such as Wheelwright and Williams. None of them doubted that mystics and witches were in actual communion with the devil, however widely they might differ as to punishment suitable for persons thus entangled.

"Stoughton called the immigrants to New England the choice grain of old England. The settlers in America included very few of the lowest class, many of the great middle or mediocre multitude, a fair proportion of the upper middle class, such as city merchants, clergymen, and undistinguished visitation families, and but few, if any, of the ruling class in Europe. Such as they were, however, they have dominated our political and intellectual life to this day. The Anglo-Saxon half of Boston, for example, produces a dozen eminent men to every leader produced by the Celtic half of the population.[5]

"Whatever their shortcomings may have been, these people, from north to south, were all of the dominant Nordic race so recently described by Mr. Madison Grant:

"'New England, during Colonial times and long afterward, was far more Teutonic than old England; that is, it contained a smaller percentage of small, pre-Nordic brunets. Anyone familiar with the native New Englander knows the clean-cut face, the high stature, and the prevalence of gray and blue eyes and light brown hair, and recognizes that the brunet element is less noticeable there than in the South.

"'The Southern States were populated also by Englishmen of the purest Nordic type, but there is today, except among the mountains, an appreciably larger amount of brunet types than in the North. Virginia is in the same latitude as North Africa, and south of this line no blonds have ever been able to survive in full vigor, chiefly because the actinic rays of the sun are the same, regardless of other climatic conditions. These rays beat heavily on the Nordic race and disturb their nervous system, wherever the white man ventures too far from the cold and foggy North.

"'The remaining Colonial elements, the Holland Dutch, the Palatine Germans, who came over in small numbers to New York and Pennsylvania, were also purely Teutonic, while the French Huguenots who escaped to America were drawn much more largely from the Nordic than from the Alpine or Mediterranean elements of France.'

"If we apply these facts a little more specifically to the portraits, we find that ninety-seven represent Englishmen, fourteen represent Dutchmen, nine are Frenchmen, two Swedes, two Germans, and one a Bohemian. In other words, eight-tenths were English, one-tenth Dutch, and one-tenth French and others."

In closing this notice of Mr. Bolton's volumes, we can only emphasize their value to students of history, sociology, and eugenics. Here historical material is brought together in the true spirit of natural science, for we have one of its valid methods exemplified, namely, the objective and complete collection of homogeneous data. Mr. Bolton is an historical investigator who recognizes the importance of genealogy and heredity and, still more of the need of systematic measurements before new historical generalizations are to be made.

These portraits, in conjunction with those in other volumes, enable us actu-

[5] *Popular Science Monthly*, April, 1914, p. 400.

A TWENTIETH CENTURY FACE

(THOMAS, LORD COLEPEPER, 1634-5—1688-9)

This type of nose was rare in the seventeenth century and rarer still in the sixteenth. Here the entire nose is delicately moulded. Especially it should be noticed that the upper part of the nose projects and is not especially broad as in most early portraits. The upper eyelid is an intermediate type. (Fig. 18.)

ally to see human evolution taking place. While it is not certain that the more modern type is indicative of a higher grade of intelligence, it is probably somehow correlated with it, though there may be many exceptions to the rule. It is at least an evolution in the sense of being a change, and it is certainly a change towards what was for the ancient Greek an ideal of beauty. If the bony structure of the face has altered, presumably through some as yet unrecognized forces of selection working in conjunction with beneficial correlations, there is good reason to hold, at least as an hypothesis, that the brains of Nordic peoples are not just as they were four hundred years ago. While it may be surprising to find that a measurable human alteration took place in so short a time, it is perhaps not so remarkable if we consider how short a period man has been on earth as compared with that for his prehuman ancestors, and how vast and complex are the possibilities of some human brains compared with anything existing in the lower animal kingdom. Verily, we have been on earth only a few benighted moments and have only just begun.

The Theory of the Environment

AN OUTLINE OF THE HISTORY OF THE IDEA OF THE MILIEU AND ITS PRESENT STATUS, by Armin Hajman Koller, Ph.D., Instructor in German, The University of Illinois. Menasha, Wis.: George Banta Publishing Company, 1918. Pp. 104.

In this little book the author has compiled and compressed an enormous number of quotations from most of the famous writers who have expressed their opinions on the influence of environment on man. The scheme of the book is historical, and the sketch extends from the Hebrew Prophets to the nineteenth century. Some quotations may help to give an idea of the scope of this book.

"The Hebrew prophets see the hand of Providence in the harmony of national fate with the configuration of the globe. Hippocrates dwells upon the regularity of climatic effect on man. Aristotle notes the action of physical environment on government and national character." In another place, page 11, we find that "Giovanni Villani, the noted Florentine historian of the fourteenth century, observes with a deal of finesse that Arezzo, by reason of its air and position, produces men of great subtilty of mind." In regard to Cuvier, Mr. Koller quotes Ripley. Cuvier "had not hesitated to trace the close relation borne by philosophy and art to the underlying geological formations." It is not difficult to understand that "Cuvier did not hesitate," especially when one recalls that he did not hesitate to attack and ruin the great Lamarck, and his plea for the doctrine of organic evolution.

Mr. Koller's English is, in places, difficult to read. A great part of his book is made up of quotations, where the various famous theorists complain of each others deficiencies or praise each other warmly. In fact his book is largely made up of quotations, or quotations of quotations. It is at least an interesting contribution to the bibliography of the subject, especially as it gives the views of so many of the early writers. Nothing is said about the non-inheritance of acquired traits or modern investigations in heredity, all of which have upset so many of the dogmatic theories of the older environmentalists. It is to be hoped that these aspects will be discussed in Part II, which the author expects to publish shortly.

WAR AND GENETIC VALUES[1]

DAVID STARR JORDAN
Stanford University, California

CERTAIN recent writers, speaking in the name of science, have attempted in different ways to minimize the recognized evils of war-selection, the destruction of the fittest in camp and in the field.

It is claimed by Dr. McFie of London, and others, that the soldier shows but slight genetic superiority (physical, mental, moral), 5% perhaps, over the men left at home. "The best for warlike purposes, not necessarily the best for any other." In the aggregate, they argue, war-selection is therefore negligible, tending at the worst to lower physical strength while leaving the mental acumen of the race unimpaired.

A writer of larger outlook, Dr. Thorstein Veblen, in his trenchant and suggestive volume "Germany and the Industrial Revolution," pushes this idea still further, regarding the reversal of selection as an undoubted fact, but of slight racial importance. Veblen bases his view on two premises: that the men killed in war do not as a whole represent high racial values, and that by the Mendelian law the descendants of the "depauperate" spared by war will in two or three generations regain the racial average.

As to the first contention, Veblen regards war as the business of the leisure classes and of the bullying type of men. The first of these he finds to be made up, in general, of inefficient social units, the second to be of inferior mental caliber. Destruction by war is thus, in his mind, largely confined to those human types which civilization can well spare.

The first contention of our author raises certain questions of fact. In general, the leisure class has been made so by incidents of wealth, society, and education. The stock is not necessarily inferior because the individual has suffered from an unfortunate upbringing. It may, of course, be at once admitted that those who find *joy* in war are in general of a low type of mind as well as of morals. Doubtless in the course of history there have been many free lances and soldiers of fortune whose extermination left the world better off. War-selection is a racial evil only to the degree in which the best are sacrificed. In modern armies the best elements are certainly drawn upon heavily. Every one knows this to be the case. Naturally the stronger the appeal of the "cause," the higher the type of men drawn to the sacrifice. To this, the selective draft, or any other form of discrimination, affords no modification.

In his second contention, Dr. Veblen urges that, according to the Mendelian principle, the ravages of war are soon restored by the tendency to revert, in mathematical proportion, to qualities of past ancestors. Thus the descendants of the weak and incapable would soon line up with the others. There is nothing in "Mendel's Law," however (so far as anyone knows), which implies that bad stock can be made good, or that any appreciable percentage of those who are, to use Veblen's term, "depauperate" through heredity, or who may suffer from other ancestral weakness, will rise above the level of their personal forbears. When the individual overtops his parentage it is

[1] This is a discussion in genetics, and for emphasis of the great and terrible truths contained therein it waives for the moment the fact that some part of the loss owing to war wastage may be balanced ultimately by advantage to humanity in the establishment of international harmony and national freedom and efficiency.—*The Author.*

because some of his still earlier progenitors were of better material or because society has misjudged the stock from which he sprang or because the mingling of germs has brought about a peculiarly favorable combination.

I find no warrant for Veblen's assertion that "under the Mendelian rule[2] of heredity, breeding from what may be called the 'depauperate' representatives of this hybrid stock should in the course of some two or three generations give the same result as breeding from the best exemplars." Nor is it true that "the best, as contemplated in this proposition, are the best for the warlike purpose, not necessarily for any other." This may have been true at some time and in some degree. It has not been true in the European wars of the last hundred years. The degree of evil in war-selection must, of course, vary with every army and with every day of war, but its importance as a factor in history cannot be questioned.

A serious view of the actual situation is expressed by Mr. Seth K. Humphrey as follows.[3]

"This war is little short of a headlong plunge into race-suicide. . . . A little play-war, offering adventure abroad, might attract . . . roving spirits whose value in any sustained effort at home is conspicuously absent, and thus not materially affect racial values. . . . It is safe to say that among the millions killed will be a million who are carrying superlatively effective inheritances, the dependence of the race's future. Nothing is more absurd than the notion that these inheritances can be replaced in a few generations. . . . They are gone forever. The survivors are going to produce their less valuable kind. Words fail to convey the appalling nature of this loss."

Again, quoting from some author not named, Mr. Humphrey gives the following excellent definition of a desirable inheritance:

"It is of that quality of brain—one might almost add quantity of brain—which leads to creative leadership in whatever activity it may select. It dominates environment and advances into new undertakings. It is the mark of the Social Migrator, the man of initiative who extricates himself from the mass and changes some bit of the world for better or for worse, by his contact with it . . . Someone has said that if France, for example, were to lose fifty of her greatest statesmen, fifty leading scientists, fifty each of her shining lights in education, art, music, there would be nothing left of France. This states in an exaggerated way a deep truth which can be more convincingly illustrated."[4]

France is here used merely as an illustration; the same line of argument applies equally everywhere. Suppose that from any nation were taken 1% of the physically best men such as not of the "very best human values, are being lost in war, but of the best in intellectual and creative ability, in leadership, in genetic worth," what would be left?

Continuing, Mr. Humphrey asks what would become of New York, if 1% (40,000) of the best were removed. "In the physical display which any active nation can make we lose sight of the rather appalling fact that its constructively effective brains are concentrated in the heads of a very small number."

There exists, of course, in the mass a certain percentage who have not yet found themselves or found means of self-extrication. There are others yet to be produced through happy combinations of ancestral traits. But high endowments do not spring from nonentity. "Ability is never careless of its

[2] No biologist who is qualified to express an opinion on the subject now fails to recognize the vast significance of Mendel's discovery. . . But these admissions in no way affect our condemnation of the flimsy superstructure of speculation which has been erected by some of Mendel's successors. (Francis B. Sumner, *Modern Conceptions of Heredity*, La Jolla, Cal., p. 4)

[3] *Mankind*, p. 13.

[4] Seth K. Humphrey, *Mankind*, p. 38.

ancestry. . . . There are no 'self-made men." for each man has within him, derived from his intertangled ancestry, the potentiality of whatever he becomes."

REPAIR OF HUMAN WASTAGE AFTER WAR

We do not yet know how many men, women, and children have been killed, maimed, or ruined in the great war. The number runs very high, far into the millions already—thirty, forty or more—according to the completeness of our statistics. To replace these incalculable losses is a problem for future statesmanship. *Restoration of numbers*, however slow, is a matter relatively simple; *renewal in quality* a difficult process.

As has been abundantly pointed out, war first devours the young, selected for strength and endurance, "the best that the nation can bring." But the devastation, immeasurable as it is, by no means stops there. For with each man who falls perishes also the great widening wedge, reaching forward through time, of those who by rights should be his descendants. "Giving his life for his country," a man gives far more than that—he yields up his proportion of the "slain unnumbered" who are never to be.

Again, in addition to the millions fallen in battle, war takes its quota of civilians. Refugees of every description, men and women, children often lost or abandoned, trampled or starved in the rush, perish along the road, or are slain through "military necessity." Furthermore, everywhere behind the lines, war takes a corresponding toll, high-minded men and women breaking under the strain of a topsy-turvy world, the feeble and aged dying from want and neglect. It is often estimated that for each soldier who falls, two or three non-combatants also perish.

As an accompaniment of all this, the shadow of enforced celibacy is spreading over the womanhood of Europe. A world in which women hopelessly outnumber the men is sadly unnatural. It means that millions fitted for love and motherhood are to be debarred from the richest joys of life.

The best will accept the situation with no lowering of moral standards. But for the mass, indications point directly to some form of semi-legalized polygamy. The common run look to the state to formulate the moral law and ask no higher sanction than tacit official approval. In Germany, a plan for "lateral" or "secondary" marriages, another name for the semi-slavery of concubinage, has been repeatedly under discussion. But polygamy, in whatever form, brings disaster to social purity. Conventions guarding the most precious jewel of society cannot be discarded without a far-reaching heritage of evil.

To recapitulate, restoration in quantity is a matter of time. Restoration in quality, in values, moral, mental, and physical, will be a much longer and more difficult process. Still for a century to come the history of Europe will disclose its failure adequately to conserve the most forceful elements of its population. But as in the long run the strong and intelligent tend to outlast the futile, the dissipated, and the lawless, we may expect that after this, as after every war, there will be an ultimate although very tardy recovery.

Game-Bird Farming Needed

General prohibition of the sale of migratory birds has created a great demand for domesticated birds to supply the markets. To meet these demands the regulations under the migratory bird treaty act, made in 1916 between the United States and Great Britain for the protection of game birds migrating between this country and Canada, make liberal provisions for the propagation of migratory waterfowl.

Permits are issued free of charge by Secretary of Agriculture, through the Bureau of Biological Survey, authorizing persons to acquire a limited number of wild waterfowl to be used as the nucleus of a breeding stock or to strengthen the strain of birds already possessed.

A NOTE ON THE DROPPING OF FLOWERS IN THE POTATO[1]

M. J. Dorsey

Head of the Section of Fruit Breeding, Agricultural Experiment Station of the University of Minnesota

THERE is considerable popular interest in the failure of many potato varieties grown today to set seed. The varieties of our forefathers are generally supposed to have set seed-balls in abundance. It has been generally held that the cooler northern States such as Minnesota furnish conditions favorable to the development of seed-balls, but recently Newman and Leonian report seed-ball production in the Lookout Mountain variety (when grown as far south as Georgia) that certainly equals seed production farther north at its best. In fact these investigators are attempting to develop varieties which will produce by seed as well as by tubers. An occasional year when seed-balls are more abundant than others is well known, but the interest of growers centers more around those years when the flowers are abundant, but seed-balls rare, if any develop. The disposition of the flowers in the last case is the theme of this article.

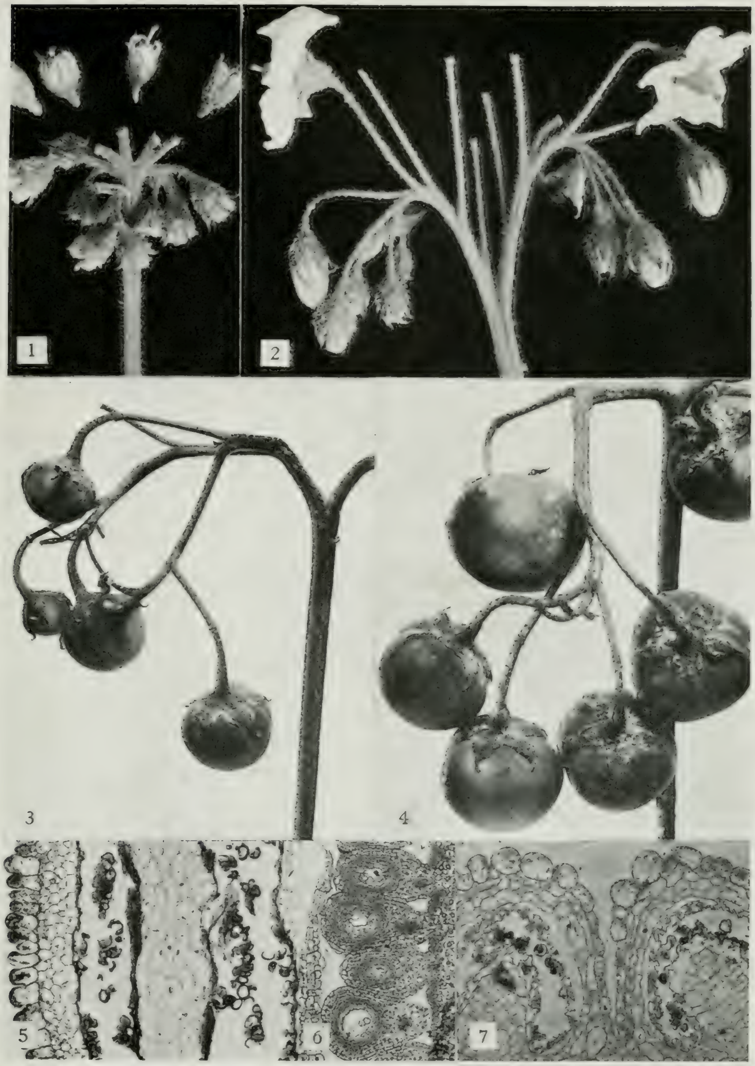
It should be stated that flower production varies from year to year and also that some varieties habitually bear fewer flowers than others. For instance, King seldom produces flowers, while Green Mountain bears them in abundance. It follows then that seed-ball production must also vary from year to year and between varieties. Some contend that seedlings bear more seed-balls than the older varieties.

Early Ohio (Fig. 19, Nos. 1 and 2) and Rural New Yorker bore flowers in abundance at the Fruit Breeding Farm in 1918; but, like so many other seasons, all fell off so that at harvest time not a single seed-ball could be found in the entire patch. What happened? An examination of the blossoms when the first flowers were open showed that both the opened flowers and buds were falling in large numbers. In some clusters there was a partial succession of bloom, but the first flowers to open fell as the later ones came into bloom. In others the younger as well as older buds were falling several days in advance of the time they were due to open. In still others the younger buds fell before those which had come into full bloom. It is unusual to find dropping taking place simultaneously in flowers differing so much in age, because in most cases flowers normally fall after maturity.

The joint in the pedicel (Fig. 19, No. 1) at which the flowers drop is three to five millimeters below the flower. There is a conspicuous swelling in the pedicel at this point, and before the flowers fall the stem is noticeably yellow in the younger buds as well as those which have opened. Buds or flowers sometimes drop on clusters in which seed-balls have already developed, and rarely even the younger seed-balls may drop. There is no abscission layer subtending the flower stalk, and after the flowers have all fallen off it persists and, in the absence of leaves at the base, dries up and can be found in this condition at maturity.

In many of the varieties a large percentage of the pollen is defective and in some no normal pollen is produced (Fig. 19, Nos. 5 and 7). Counts in a

[1] Published with the approval of the Director, as Paper 161 of the Journal Series of the Minnesota Experiment Station.



POTATO FLOWERS

(1) Early Ohio, flowers dropping before opening; (2) Early Ohio, flowers dropping after opening; (3) seed-balls setting on a cross between Keeper and Silverskin; (4) same as No. 3, showing greater development; note that some of the flowers on these two clusters have not set seed-balls; (5) longitudinal section of anther showing complete pollen abortion; (6) apparently normal ovule development in flowers which generally drop; (7) cross-section of an anther showing, as in No. 5, practically complete pollen abortion. (Fig. 19.)

few of the common varieties showed the following percentages of defective pollen: Beauty of Hebron, 30%; Early Norther, 44%; Early Rose, 60%; Green Mountain, 67%; White Elephant, 58%, and in a hybrid between Keeper and Silverskin, 89%. When pollen is taken from mature anthers and mounted in lactic acid the defective grains appear empty. The fact that there are empty pollen coverings in the loculi indicates that pollen development is stopped after being liberated from the tetrad. In anthers where there is complete pollen abortion at maturity the pollen appears white instead of the characteristic yellow. After dehiscence the anthers curve backward away from the style. It would appear from the above percentages, that while all of the varieties bear considerable quantities of aborted pollen, in most cases there would be ample normal pollen for self or cross pollination. In one collection of flowers from Early Ohio and Rural New Yorker there was nearly complete pollen abortion. If this were generally the case large fields of either of these varieties would fail to set seed-balls even if the flowers did not drop.

An examination of the pistil, on the other hand, shows that the ovules undergo normal development (Fig. 19, No. 6). There are evidences of disintegration in some embryo sacs but on the whole they appear to be undergoing the usual growth up to the time they are cut off when the flower drops. Some of the pistils are whitish in color at the base instead of distinct green before the flowers drop, and in those flowers which drop after opening, the abscission layer at the base of the style forms, and occasionally a flower persists long enough for the style to absciss. Receptive stigmas have very few pollen grains on them under field conditions. It often happens that seed-balls develop but bear few mature seeds. Apparently the stimulus from these is sufficient to hold the balls on.

What relation then does the dropping of flowers in the potato bear to the normal functioning of pollen and pistil? Since complete abortion of pollen occurs in many forms in which the pistil functions normally, this factor is not necessarily a cause of dropping, although pollen development is carried up to the liberated microspore. The pistil develops ovules and the stigma becomes receptive in the maturest flowers which shows that normal pistil development takes place in flowers in which the pollen is suppressed. Since the flowers are cut off before the stimulation resulting from pollination or fertilization takes place, this factor can be eliminated. Bloom, likewise, precedes any considerable storage of food material in the tuber. It appears then, that there are physiological influences operating independently of pollen or pistil development which cause the potato flower to drop.

Robert Louis Stevenson on Heredity

"Our conscious years are but a moment in the history of the elements that build us. . . . And though today I am only a man of letters, either tradition errs or I was present when there landed at St. Andrews a French barber-surgeon to tend the health and the beard of the great Cardinal Beaton: I have shaken a spear in the Debatable Land and shouted the slogan of the Elliots; I was present when a skipper, plying from Dundee, smuggled Jacobites to France after the '15. . . . Yes, parts of me have seen life, and met adventures, and sometimes met them well. And, away in the still cloudier past, the threads that make me up can be traced by fancy into the bosoms of thousands and millions of ascendants: Picts who rallied round Macbeth and the old (and highly preferable) system of descent by females, fliers from before the legions of Agricola, marchers in Pannonian morasses, star-gazers on Chaldean plateaus."

THE FOUNDERS OF THE ART OF BREEDING—III

Pre-Mendelian Breeders of the Nineteenth Century

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IN 1819 the Physical Section of the Royal Prussian Academy of the Sciences offered a prize for an answer to the question—"Does hybrid fertilization occur in the plant kingdom?" and this, despite the fact that as far back as 1761, Koelreuter, in the preface to his published work, had flattered himself with the hope that now "even the most stubborn doubter of the truth of the sexuality of plants would be completely convinced." "If, contrary to all conjecture," he says, "there should be such a one, who after a rigid examination, still maintained the contrary, it would astonish me as greatly as though I heard someone on a clear mid-day maintain that it was night." Fifty-six years after this utterance, however, the Prussian Academy still sought light in the darkness that Koelreuter had flattered himself to have dispelled.

On the third of July, 1826, the Academy's prize was conferred upon Dr. A. F. Wiegmann, physician of Braunschweig. Since the investigation did not, in the Academy's opinion, furnish a complete solution to the question, but half instead of the whole of the prize was granted. The award was made in the following language: "The author has described the results of his investigation with appropriate brevity. These results are in part completely convincing, and in part not," the reason being given that certain of Wiegmann's hybrid specimens submitted scarcely showed evidence of being of a hybrid character. Since, on the other hand, Wiegmann's results completely confirmed and extended those of Koelreuter, and especially by reason of his determination of the fact that self-fertilized hybrids may bear fertile seeds, it was decided to grant an award.

Wiegmann, through forty years of observation, including the fact of having actually produced two geranium crosses as early as his sixteenth year, was already predisposed toward the affirmative of the question submitted. His investigations, begun in 1822, were finally published in 1828. In order to overcome all possible criticisms from the opponents of the idea of sexuality in plants, which he considered might be directed against what he refers to as "an unnatural handling of plants in pots," he conducted his operations in the open ground, in connection with which he alludes to the several hindrances he was obliged to undergo, "weak sight, a trembling hand, and painful bending and kneeling" (p. 2).

Wiegmann refers to the many failures encountered, including the attempted repetition of a number of Koelreuter's experiments, as being probably due in part to having attempted crosses between different genera, "since many stigmas, according to my numerous experiments, take the pollen of too distant genera either not at all, or with extreme difficulty" (p. 2). "Plants which together are to produce hybrids," he says (p. 26), "must have some relationship with one another, as Koelreuter has already remarked. The nearer the parent plants are related to one another, the more easily will hybrid fertilization succeed; most easily in the case of different sub-species or varieties; then different species of the same genus; less easily in the case of plants of different genera."

Wiegmann, however, was completely free from any rigid dogmatic attitude on the species question. His views in this regard are completely modern.

Continuing the above, he says, "Yet at the same time, one needs indeed pay less attention to differences based on artificial generic characters. Genera like *Pisum* and *Vicia*, *Ervum* and *Vicia*, *Lychnia* and *Cucubalus*, are in their nature so related that hybrids can arise from them, as Koelreuter and I have demonstrated" (p. 27). "So much the more I dispute his opinion," he says of Koelreuter (p. 25), "respecting the falsely derived difference between true 'species' and 'variety' from the fertility or infertility of the hybrid plants."

CHANCE CROSSING IN NATURE

Wiegmann in fact regards chance crossing in nature, between species or sorts of plants, as having given rise to new agricultural races. "It appears from my experiments," he says (p. 26), "that many species, or constant subspecies, *e. g.*, *Pisum arvense*, *Vicia leucosperma*, *Vicia faba* (red-seeded), as well as the most of the varieties of cabbage and the cereals, whose origin is unknown, possibly are hybrid plants, which have been produced upon our fields and in our gardens, through the proximity of a few related plants, and which have remained constant."

Wiegmann sums up the matter of the bearing of degree of relationship upon crossing as follows (p. 27): "Mainly it comes to the point that the different plants do not vary from one another greatly in their natural constitution, and that their secretions are not too heterogeneous, since otherwise the pollinating substance would not be absorbed by the stigma. "In general," he says, "foreign pollen takes hold of the stigma with much greater difficulty than does its own, and in order to obtain complete fertilization, one must often deposit it several times, even when the foreign pollen is from a plant of the same species" (p. 3).

Wiegmann's experiments covered a list of thirty-six crosses, using the following species and cultivated varieties:

Allium (onion, etc.), 2 species.

Brassica (cabbage, etc.), 4 race-species.

Dianthus (pink), 3 species.

Ervum (lentil), 1 species.

Nicotiana (tobacco, etc.), 2 species.

Phaseolus (bean), 2 varieties.

Pisum (pea), 2 species.

Vicia (vetch), 1 species.

The general conclusions Wiegmann draws from his experiments are most interesting. The most important are those which relate to the possible vigor of new species (p. 3): . . . "My experiments sufficiently prove," he says, "that the fertilization of different subspecies, *inter se*, is a source of manifold running-out of species in the plant kingdom, and that insects, especially bees and humblebees, as well as little beetles and flies, play a much more important rôle in the fertilization of plants than one has lately been inclined to allow them, but of which I have the most indubitable proofs."

"Even though the structure of the corolla in the case of leguminous plants," he says again (p. 26), "scarcely appears to admit of the access of insects and foreign pollen, yet the plants obtained from the seed of experimental plants show such a striking alteration in their specific characters, especially in the form of the seed and its envelopes, that an influence of foreign pollen on the ovules will scarcely be able to be denied. I myself have numberless times convinced myself of the fact that humblebees, bees and small insects from the orders of flies and beetles, can fertilize the flowers of the Leguminosae in the manner stated by Sprengel. It is therefore necessary in agriculture to give heed to this matter, if one wishes to keep plants that are to be cultivated, in their quality and integrity."

With respect to observations of a more special nature, Wiegmann's memoir contains much of interest. Regarding the breaking up of the progeny of hybrids, he says, speaking of Koelreuter's observations: "I have found his observation well founded, that the plants produced from one seed and from one capsule of hybrid plants often differ from one another in respect to fertility, and especially in the struc-

ture of certain parts, now approximating more to the father, now to the mother" (p. 25).

Wiegmann's independence of traditional authority is witnessed in his contradiction of the view of "the great Linnaeus," that hybrids resemble the mother in the fertilization apparatus and the father in foliage and habit. Instead, he says: "the change through the foreign fertilizing pollen shows itself in very different parts in different plants; in the anther filaments, . . . in the inflorescence, in the form, color, and odor of the corolla, in the height of the stem and its divisions, in the form and outside covering of the leaf" (p. 23).

Referring to the then general assumption that hybrids (of the F_1 generation, as we should say) occupy a mid-position, with respect to their characters, between the two parents, he says: ". . . in many cases this does not occur, but either the color of the father or that of the mother shows itself alone dominant (herrshend) in the hybrid. The same also obtains among animal hybrids; the two colors may, through mingling, give an intermediate one, but in just as many cases the one only prevails. Plant hybrids therefore unite in themselves in part the peculiarities of the father, in part those of the mother, whereby they approach now the maternal, now the paternal form" (p. 21).

THE QUESTION OF DOMINANCE

Regarding the matter of dominance, Wiegmann further incidentally remarks upon the case of the crossing of two species of Dianthus, where "the form of the father has almost entirely suppressed that of the mother" (p. 22).

To present-day geneticists, one of the most interesting points in Wiegmann's report is his discussion of the immediate effect of the pollen in the case of peas. According to his statement, that there occurs, "even immediately after fertilization, an alteration arising in the form and color of the seed, and in the form and size of the pods, is especially unmistakable in the case of the leguminous plants, although otherwise all fruits and seeds of hybrid plants from other families, have never shown themselves to me to be different from those of the mother plants" (p. 23). And again, "The principle expressed by Gärtner, that the influence of foreign pollen changes nothing in the form and external character of the fruits and seeds of the mother plant, should, according to my investigations, undergo a modification in the case of the Diadelphia (Leguminosae), since, in the case of these, the foreign pollen exerts an immediate effect upon the form, color, and other characters of the fruits and seeds" (p. 29).

In the case of Phaseolus (common bean), he says; "Previous experiments have taught me that Phaseoli of one species, but of two kinds of flowers and seeds, when placed together, bear differently colored seeds, and, in the second generation, also differently colored flowers" (p. 23).

Wiegmann carried on some field experiments with beans, vetches, oats, and cabbage, in which adjoining rows of plants were allowed to freely cross-pollinate through the agency of wind and insects, from which he concluded: "It appears further, from the behavior of the Leguminosae and of cabbage, that agronomists and gardeners cannot be careful enough in the arrangement of their fields, in order not to suffer from the great damage through hybrid fertilization occurring even the first year" (p. 36).

Speaking generally, he says further (p. 30): "It is not entirely improbable that that which exhibited itself to me thus far, as being peculiar to the Leguminosae alone, may take place also among other plant-families, and the clearing up of this matter remains very desirable for botany, as well as for agriculture in particular" (p. 30).

Wiegmann's work, as a whole, impresses one as the work of a man without scientific prepossessions, willing to investigate for himself, to dispute freely the authority of other investigators such as Linnaeus, Koelreuter, and Gärtner, and, withal, a man with a practical bias and a sympathy for agriculture.

In the valley of the Nagold, in the Black Forest region of Württemberg, some 40 miles southwest of Stuttgart, the capital, lies the village of Calw. Here Koelreuter, whose home was in Sulz, a little way to the south in the Neckar valley, lived for a time, and did some of his work on hybridization, in the garden of a local physician. By a curious coincidence, in the same village of Calw in which Koelreuter had previously worked, and but 40 miles north of Sulz, where also Koelreuter had formerly obtained the first hybrid plant ever produced in a scientific experiment, lived and died Carl Friedrich von Gärtner, who for twenty-five years conducted extensive experimental work in hybridization. He was a son of the distinguished botanist Joseph Gärtner, Professor at Tübingen and St. Petersburg, and author of an authoritative work on the seeds and fruits of plants, in which figured the morphology of more than a thousand species. The introductions to the volume for 1788 contain, in the words of Sachs, "valuable reflections on sexuality in plants."

In 1830, two years after the appearance of Wiegmann's memoir, the Dutch Academy of Sciences at Haarlem, propounded the riddle of hybridization anew in the following words: "What does experience teach regarding the production of new species and varieties, through the artificial fertilization of flowers of the one with the pollen of the other, and what economic and ornamental plants can be produced and multiplied in this way?" No reply was received by the end of the time for which the prize was offered (January 1, 1833), and the offer was accordingly renewed for another three years (until January 1, 1836).

In October, 1835, Gärtner learned of the prize offer and was able to present a brief résumé of his work up to that time, which, indeed, prompted a further extension of time on the part of the Academy. Gärtner finally presented the Academy with a memoir of two hundred pages, and with herbarium mounts of one hundred and fifty different sorts of hybrid plants produced by hand pollination. On May 20, 1837, this memoir received the prize and was later (April 20, 1849), published in revised and extended form, together with an extensive list of the experimental material, and with the obtained results arranged in tabulated form.

An idea of the amount of labor expended by Gärtner during the twenty-five years of his hybridization experiments may be obtained by the statement that he carried out nearly ten thousand separate experiments in crossing, among about seven hundred species, belonging to eighty different genera of plants, and obtained in all some two hundred and fifty hybrid plants as the total result.

Among the prominent genera worked with were Althaea, Avena, Campion, Columbine, Currant, Datura (Jimson weed, etc.), Fox-glove, Fuchsia, Gladiolus, Larkspur, Lobelia, Maize, Mallow, Mullein, Nicotiana (Tobacco, etc.), Oenothera (Evening Primrose), Pink, Poppy, Primrose, Snapdragon, St. Johnswort, and Stocks.

The following brief table, giving some of the numerical data, in crosses involving a few of the principal genera, will afford a conception of Gärtner's labors; yet these constitute but one-tenth of the total number of his crosses.

Genus	*No. of species used in the crosses*	*No. of attempted combinations*	*No. of hybrid plants obtained*
Nicotiana (tobacco, etc.)	23	432	85
Dianthus (Pink)	20	349	87
Lychnis (Campion)	..	137	18
Verbascum (Mullein)	14	118	97
Lobelia	4	97	20
Digitalis (Foxglove)	9	59	14
Datura (Jimson weed, etc.)	8	55	16
Oenothera (Evening Primrose)	19	52	6
Aquilegia (Columbine)	9	33	23
	107	1332	366

Gärtner undertook to classify hybrids for convenience into three types: (1) intermediate, (2) commingled, and (3) decided. The first included those in which "a complete balance occurred of both fertilizing materials, either in respect to mass or activity" (p. 227). Commingled types are those in which "now this, now that part of the hybrid approaches more to the maternal or to the paternal form, whereby, however, the characters of the parents, in their transference to the new organism, never go over pure, but in which the parental characters always suffer a certain modification" (p. 282). Under the third class of hybrids, Gärtner places those "among which the resemblance of a hybrid to one of its parents, either to the father or the mother, is so marked and preponderating that the agreement with the one or with the other is unquestioned" (p. 285).

Gärtner recognized, as did the other hybridizers of his day, that there was always a difference between the first and the succeeding generations, the former being uniform, the later ones variously splitting up. He made no distinction between the second and the other following generations, and simply says that the fundamental ground material of which the hybrid is made "behaves differently in the second and in the further stages of breeding, where, on account of the different nature of the two factors of the hybrid in the succeeding fertilizations, an altered, shifting, variable direction in type-formation enters into the arising varieties" (p. 572).

He further says, concerning variability in hybrids of the second and succeeding generations: "Other hybrids, and in fact the most of them which are fertile, present from the seeds of the second and further generations, different forms, *i. e.*, varieties, varying from the normal types, which in part are unlike the original hybrid mother, or deviate from the same, now more, now less" (p. 422).

Gärtner's most definite statement, however, regarding what we call "segregation" in the second hybrid generation, is as follows: "Among many fertile hybrids, this change in the second and succeeding generations affects not only the flowers but also the entire habit, even to the exclusion of the flowers, whereby the majority of the individuals from a single cross ordinarily retain the form of the hybrid mother, a few others have become more like the original mother parent, and, finally, here and there an individual more nearly reverted to the original father" (p. 422).

Gärtner did not fail to recognize the fact of unusual vigor in hybrids, although he does not distinguish as to the generation: "The marked increase in the size of the flowers is a phenomenon not seldom occurring among hybrids" (p. 295); and "one of the most marked and general characters of plant hybrids is the luxuriance of all their parts, since, among very many of them, an exuberance of growth and development of roots, branches, leaves and flowers manifests itself, which is not encountered among the parents, even under careful cultivating" (p. 526).

PRACTICAL POSSIBILITIES

Gärtner recognized at once the possibilities for agriculture in this fact of the increased vigor of hybrids, although, of course, he did not realize the fact that this increased vigor belonged to the first or hybrid generation, properly so called: "Among the characters of hybrids worthy of recommendation for agriculture, their tendency toward luxuriance in stalks and leaves and their extraordinary capacity for tillering is related above. With respect to the raising of forage, agriculture could, without doubt, make great use of this characteristic" (p. 634).

Gärtner derived, from his long experience, a certain philosophy concerning the nature of hybrids which is noteworthy. He recognized an inequality in the influences or the "potency," as he termed it, of one parent over another in a cross, which potency was maintained, whichever way the cross was made. As we now understand it, it

means the relative dominance of one or more factors or character-units of the parents. Gärtner, not having the knowledge which has come since and in consequence of Mendel's investigations, sought a theoretical explanation for this phenomenon of dominance and gave it the designation of "sexual affinity)' (Wahlverwandschaft) in the crossing of species, the magnitude of which he considered could be measured by the number of viable seeds produced in the cross. Gärtner seems to confuse the matter by appearing to indicate that there might possibly be a different number of seeds produced by the reciprocals of reciprocal crosses, thus presumably indicating a possible "prepotency," so called, of one of the parents in the cross. In other places he simply seems to mean the relative influence, so to speak, of such and such species when crossed with others. This appears to be the meaning in the following:

"This manifestation of generic types, according to which one species acts in a predominant manner over several other species in hybrid breeding, is a further uncontradictable proof that the relationship of the forces, through which the union of two pure species takes place, must be unlike, and that thereby there can be no question of any balance of factors" (p. 290).

It will be seen that Gärtner's view of hybridization was that "species" was crossed with "species" as such, each species as a whole exerting its own relative power or potency in the cross—the hybrid being regarded as the resultant, so to speak, of the contest for supremacy of the two competing natures in the compound. This view is well enough expressed in the following passage: "Thus, just as there are species in a natural genus, which possess a prepotent fertilizing power upon several other species of their genus, so there are also species which exert upon several others such a typical predominating effect, not to an equal extent, to be sure, but still of such a nature that their operation, in all combinations, is to be recognized by a character in common. Both of these forces are, however, of different kinds and follow different laws" (p. 289).

Gärtner did not realize, in spite of Sageret's experiments, that some individual characters of a parent might be found to dominate in a cross and others not. "The laws of hybrid types orient themselves, not toward the individual organs of plants—do not apply to a single part, *e. g.*, stems, leaves, etc.—but are applicable rather to the inner nature of species. The organs which determine the types of hybrids must therefore be investigated and compared in their totality and in their mutual inter-relationship. For the most part, the individuality of a hybrid expresses itself in its entire habit, but in this respect the flower, above other parts of the plant, is most frequently and plainly distinguished" (p. 251).

Gärtner made some crosses with corn and with peas to determine the question of the immediate influence of the pollen upon the character of the seed. In corn he got no results, because of crossing white corn with red, in which latter the color, being due to the skin or pericarp, does not show until the seeds of the following season ripen. In peas he crossed four varieties. In certain crosses, *e. g.*, Paris Wax (yellow) × Sugar Pea (greenish-yellow), Early Green Brockel (green) × Paris Wax (yellow), and Sugar Pea (greenish-yellow) × Dwarf Creeping (yellow), the yellow color dominates over the green in the hybrid seeds.

Gärtner's work is noteworthy, not only for the remarkable number of species with which he experimented but for the scrupulous care which he exercised in his operations, if we may judge from his own statements; as, for instance, the following:

"For complete assurance of the purity and reliability of the products of hybrid breeding, and for testing the conclusions derived therefrom, we have repeated most of the experiments, especially the doubtful cases, not once only, but several times, and put them to the test through crossing of the same species, for even with the most scrupulous foresight and precision, individual

rare instances have still occurred in these tedious and wearisome investigations, where the suspicion had made itself felt, of a mistake or error having crept in, either in pollination or emasculation, since such results stood in direct contradiction to the usual experiences, and on a repetition of the experiments, made itself incontrovertibly evident as an error. We believed it possible to attain no higher degree of certainty in this branch of natural science, and to be able to bring the conclusions derived therefrom to no higher proof, than through the precise coincidence of the forms of the products, by repetition under the same conditions with the same species, but with different individuals, and at different times" (p. 675).

THE ENGLISH BOTANISTS

At the beginning of the nineteenth century, there began to appear, in England, the first signs of the application of the science of hybridization to the practical art of breeding, in the work of Thomas Andrew Knight and William Herbert.

THE WORK OF KNIGHT

Knight was a country gentleman by occupation, born August 12, 1759, and educated at Oxford, and who early began to interest himself, on his estate at Elton in Herefordshire, in experiments in the raising of new varieties of fruits and vegetables. In 1795 his work as a horticulturist first became known through some papers read at the sessions of the Royal Society. He was an organizer of the Horticultural Society of London, founded 1804, of which he was president from 1811 until his death in 1838. He was an annual contributor to its "Transactions" and was the author of upwards of one hundred papers. In 1841, three years after his death, a collection of eighty-two of his papers was published by the botanists Bentham and Lindley. Of Knight's published papers, forty-six are enumerated in the Royal Society's Catalogue. Knight was not a scientific man, but a practical horticulturist with scientific instincts, who proceeded on the principle that the improvement of plants depended upon the same scientific laws as the improvement of animals, and that cross-breeding was the key to the origination of new and improved sorts. His principal work of crossing was carried out with currants, grapes, apples pears, and peaches, to the end of producing hardier and superior fruits. One of his discoveries of genetic interest was that, in crosses of varieties of red upon white currant, by far the greater number of the hybrids produced red fruit, *i.e.*, the dominance of red. A conclusion formulated by Knight on the basis of his experience, and afterwards confirmed by Darwin, and since called the Knight-Darwin law, was that "new varieties of every species of fruit will generally be better obtained by introducing the farina (pollen) of one variety of fruit into the blossom of another, than by propagating from one single kind."

However, the work of Knight that attracts the most attention from the standpoint of genetics is his experiment with peas. The paper in question, read before the Horticultural Society, June 3, 1823, was entitled: "Some Remarks on the Supposed Influence of the Pollen, in Cross-breeding, on the Color of the Seed-coats of Plants and the Qualities of Their Fruits." This paper is really, in part, a reply to certain phases of the experiments of John Goss upon the same plant. Knight's introductory statement, which follows, is a curious reminder, in point of form, of Mendel's own introduction to his report upon his experiments with peas nearly half a century later:

"The numerous varieties of strictly permanent habits of the pea, its annual life, and the distinct character in form, size and color of many of its varieties induced me, many years ago, to select it for the purpose of ascertaining, by a long course of experiments, the effects of introducing the pollen of one variety into the prepared blossoms of another. My chief object in these experiments, was to obtain such information as would enable me to calculate the prob-

able effects of similar operations upon other species of plants, and I believe it would not be easy to suggest an experiment of cross-breeding upon this plant, of which I have not seen the result, through many successive generations."

In the particular experiment in question, Knight determined that, in crossing a pea with grey seed-coats upon one with white seed-coats, no immediate change took place, but that the resulting hybrid seeds produced plants the next year which uniformly bore grey seeds, as well as having the purple-colored stems and flowers of the male parent. He further discovered the fact that by crossing plants grown from these (heterozygous) grey seeds, with pollen from what he calls a "permanent" white variety, plants of two types appeared, one bearing grey and the other white seeds—in other words, the result of the cross of a recessive white upon a hybrid dominant grey, as we should say nowadays. No numbers are reported, so that a scientific basis of ratios, as later found by Mendel, was not laid. Despite the fact that Focke says (p. 436) "he has contributed more to our knowledge of hybrids than any other writer during the first half of the nineteenth century"—a statement which may well be seriously disputed—it is nevertheless true that Knight was the first experimenter to apply the science of plant hybridization to plant improvement. Although endowed with scientific insight of no mean order, his chief claim to recognition lies in the fact that he possessed a practical instinct for getting improved orchard fruits into existence.

The following examples will serve to illustrate the nature of his results. Of his currant crosses, he says: "Five varieties, three red and two white, out of about two hundred, appeared to me to possess considerably greater merits than either of their parents, and one of the red will, I believe, prove larger than any red currant now in cultivation."

By crossing the "Noblesse" peach (female) by "Nutmeg," (male), he obtained about twenty seedlings, of which three "appeared better peaches than I previously possessed." Of one of these he says: "Its fruit has attained a more uniform degree of perfection than I have ever witnessed in any other variety. The trees have also been free from every vestige of mildew, in the situation where the disease is very prominent, and have entirely escaped the attacks of insects."

As to the result of his crosses of apple varieties with the Siberian Crab, with the object of producing fruits that would ripen in cold and exposed situations, he says: "The plants thus produced seem perfectly well calculated in every respect to answer the object of the experiment, and possess an extraordinary hardiness and luxuriance of growth."

WILLIAM HERBERT

The work of William Herbert was to a considerable extent contemporary with that of Knight. Born January 12, 1778, son of the Earl of Carnarvon, educated at Eton and Oxford, he was trained for the bar, which he finally left for the Church, entering orders and finally becoming Dean of Manchester. Fond of outdoor life and sport, he possessed also, in addition to literary talent, an instinct for plant studies. Herbert worked largely on the improvement of florists' flowers, but also conducted experiments with some agricultural plants. He was engaged for a considerable time upon his own experiments, before he came upon the work of Koelreuter, which he immediately assimilated and estimated at its true value, as the following comment indicates:

"The first experiments, with a view to ascertain the possibility of producing hybrid vegetables (plants) appears to have been made in Germany, by Koelreuter, who published reports of his proceedings in the Acts of the Petersburgh Academy between fifty and sixty years ago. Lycium, Digitalis, Nicotiana, Datura, and Lobelia were the chief plants with which he worked successfully, and as I have found nothing in his reports, to the best of my recol-

A PIONEER IN THE STUDY OF HEREDITY

Thomas Andrew Knight (1758-1838)

An English horticulturist who published in 1795 his views on the inheritance of diseases among fruit-trees, which attracted much attention. (Fig. 20.)

lection, opposed to my own general observations, it is unnecessary to state more concerning his mules, than the fact that he was the father of such experiments. They do not seem to have been at all followed up by others, or to have attracted the attention of cultivators or botanists as they ought to have done; and nothing else material on the subject has fallen under my notice of earlier date than Mr. Knight's report of his crosses of fruit trees, and my own of ornamental flowers, in the Transactions of the Horticultural Society of London. Those papers attracted the public notice, and appear to have excited many persons, both in this country and abroad, to similar experiments."

Herbert's experimental work was animated by the conviction of the fact which he felt himself to have established, that the then current botanical dogma was wrong, which regarded the existence of sterile offspring from a cross, as evidence that the two parents were of different "species." His views were contrary to those held at the time by Knight, in common with many botanists, "that the production of a fertile cross was proof that the two parents were of the same species," assuming, as a consequence, "that the sterile offspring was nearly conclusive evidence that they were of different species; and this dictum was advanced without suggesting any alteration in the definition of the term 'species,' but leaving it to imply what it has before universally signified in the language of botanists."

A PRECURSOR OF MENDEL

Besides the work of Knight and Herbert, an experiment from the first half of the nineteenth century, which has elicited considerable interest, because of its suggestion of the later discoveries of Mendel, is that of John Goss, of Hatherleigh, in Devonshire, England, with garden peas. In the summer of 1820, Goss pollinated flowers of the Blue Prussian variety with pollen of a dwarf pea known as Dwarf Spanish, obtaining, as the result of the cross, three pods of hybrid seeds. In the spring of 1821, when he opened these pods for planting, he was surprised to find that the color of the seeds (*i. e.*, of the cotyledons), instead of being a deep blue like those of the female parent, was yellowish-white like that of the male. Here was evidently a case of complete dominance of yellow-white over blue cotyledons. However, the plants growing from these seeds in that season "produced some pods with all blue, some with all white, and many with both blue and white peas in the same pod." Here was evidently a plain discovery of the fact of segregation, according to what later became known as Mendel's law. The following spring (1822) he separated the blue peas from the white, sowing the seeds of each color in separate rows. He found that the blue seeds, which we should now call the "recessives," produced in turn only blue seeds; while the white seeds, or "dominants" as they are now called, "yielded some pods with all white, and some with both blue and white peas intermixed." Here, then, is the typical case of the segregation of the heterozygotes or hybrid dominants.

Although Goss in this experiment undoubtedly made evident the facts of dominance and of segregation, he did not recognize them as such, nor did he, apparently, sow the seeds of his different plants separately, or make counts of the number of seeds of the two colors found on each separate plant, as did Mendel in his experiments. Goss was chiefly interested in the question of the possibility of the "new variety" having superior value as an edible pea, and yet remarked that, in case it possessed no superior merit, that there yet might be "something in its history that will emit a ray of physiological light." However, the "physiological light" did not appear until after the rediscovery of Mendel's papers in 1900. The paper of John Goss was read before the Horticultural Society, October 15, 1822. At the meeting of the 20th of August preceding, a communication was read on the same subject from Alexander Seton. Seton had pollinated the flowers

of the Dwarf Imperial, a grey-seeded pea, with the pollen of a tall white-seeded variety. One pod with four peas was produced, all of which were green, *i. e.*, the dominance of green cotyledon color over its absence (white). The plants growing from the four peas (F_1 seeds, as we should call them) were intermediate in size between the two parents, and the pods, on ripening, "instead of their containing peas like those of either parent, or of an appearance between the two, almost every one of them had some peas of the full green color of the Dwarf Imperial and others of the whitish color of that with which it had been impregnated, mixed indiscriminately and in undefined numbers; *they were all completely either of one color or the other, none of them having an intermediate tint.*" (Italics inserted.)

Here again were recorded the phenomena of dominance and of segregation, but owing to the fact that the numbers of seeds of each color of each plant were not counted and recorded separately, the results were not available for scientific purposes, nor would they have aroused attention any more than those of Goss, except for Mendel's later work with the same kind of plants.

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(*To be continued*)

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX contains only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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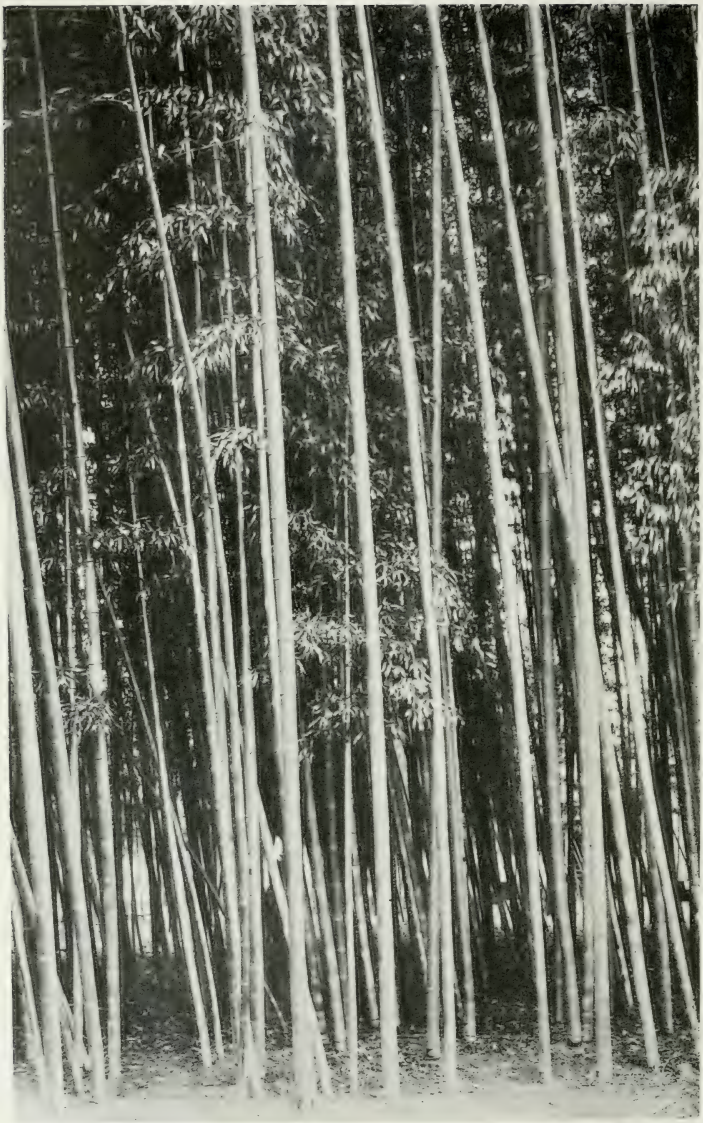

THE ORIENTAL TIMBER BAMBOO AS IT GROWS IN THE UNITED STATES

A view in the edge of the Barbour Lathrop Bamboo Grove near Savannah, Georgia. It is not generally k nown that this "giant" bamboo of China and Japan is successful throughout a wide area in the southern part of the United States. In addition to its ornamental value, the bamboo is one of the most useful of plants. (Frontispiece.)

THE BARBOUR LATHROP BAMBOO GROVE

David Fairchild

WHILE traveling in search of plants in Japan in 1902, Mr. Barbour Lathrop and I became interested in the possibilities of the cultivation of the Japanese bamboo in America. Acting under the stimulus of his enthusiasm, I wrote a bulletin on the subject for the Office of Foreign Seed and Plant Introduction.[1] Seventeen years have passed since then, bringing added experience to us in regard to this subject—experience which has resulted in the firmest conviction that from the Carolinas to the Gulf, wherever the soil conditions will permit, groves of the Japanese bamboo can be grown that will be as large and as beautiful as any in Japan.

We are now growing in this country both the timber and the edible bamboo, with stems as tall and with plumes of foliage as feathery as anything to be seen in Japan or China, and there is no reason why, at thousands of places, we should not start small groves of this plant which the Orientals have for thousands of years considered the most useful plant in the world.

It is a strange thing to consider that on one side of the Pacific there are civilizations comprising hundreds of millions of people who are so dependent upon the bamboo that they simply cannot imagine an existence without it, whereas, on the other shore, a hundred million people live whose main contact with the plant is through its use as a fishing pole.

Now that the experiments begun by the Government in 1902 and the many individual trials of the plant, which were begun earlier, have shown how easily the bamboo can be grown, the task is before us of instructing the American farmer in the uses and value of this remarkable plant. In order to do this, material in considerable quantities will be required, and it is a most fortunate circumstance that at this critical point in the development of the industry in this country, Mr. Lathrop, who has fathered its introduction, should not only save from probable destruction the most remarkable grove of bamboo in eastern North America, but that he should place it in the custody of the Department of Agriculture for ninety-nine years, in order that the timber which it produces and the thousands of young plants which can be taken from it may be placed by the Government in the hands of the manufacturers on the one hand and the farmers on the other to experiment with.

The grove which Mr. Lathrop has recently acquired is located on the Ogeechee Road, 14 miles from Savannah, Georgia. The Dixie Highway passes by it on that stretch which connects Savannah and Brunswick, and every lover of plants would find that the experience of a few minutes in this unique grove rivals any of the other new experiences of a motor trip through the south, for a bamboo grove is strangely different—unusually so—from any other growth of trees in the world.

The dense, deciduous tropical forests of Java and Sumatra, the evergreen fir and spruce forests of Canada, the eucalyptus-covered plains of Australia, the rainy region jungles of Brazil, the date palm groves of Egypt, or the fern tree forests of Hawaii are all different from each other, but they have this in common—the trees have trunks, and

[1] Fairchild, David G., Japanese Bamboos and Their Introduction into America. Bul. 43, Bureau of Plant Industry, Office of Foreign Seed and Plant Introduction, 1903.

THE BEGINNING OF THE BARBOUR LATHROP BAMBOO GROVE

When this photograph was taken, about 1900, the bamboo plants were just tall enough to be seen over the roof of the house. They were then about 10 years old and had all grown from a single plant which Mrs. H. J. Miller, of Savannah, planted in the back-yard near the pump. She got the original rhizomes from a small planting near Burroughs, Ga., which was set out by Mr. Andrias E. Moynelo, who brought a plant from "India." Compare this with the following photograph. (Fig. 1.)

THE SAME GROVE NINETEEN YEARS LATER

From a single clump planted by Mrs. Miller have come all the tall feathery shoots which now tower far above the house, shade it, and protect it from the wind. They form what is without doubt one of the most attractively shaded dooryards in America for children to play in. Compare this with the photograph taken from the same point 19 years previously (the old store shown in the previous photograph has been removed). (Fig. 2.)

above them are the spreading branches or branch-like leaves. They agree in a general way with one's conventional idea of a tree. A bamboo grove, however, is a different thing entirely. It is a giant grass. Like a grass it forms a perfect mat or sod of roots, which completely fill the ground, and like a grass this sod in the spring sends up everywhere new young shoots which, instead of starting out as miniature forms of the trees they are to become—growing slowly larger with each passing year—come up full sized through the ground, and they come with a rush, raising the soil and cracking it as a mole does. Often 4 inches in diameter, these shoot skyward at the rate of a foot a day, until they stand towering above you 50 or 60 feet in the air. Put your hand on one of these new shoots, green as an asparagus shoot. If you shake it, the top will snap off and fall down on your head, so soft and brittle does it remain until it has reached its full height and spread out its delicate branches of thin green leaves.

On all sides, so close that you can just walk between them, rise these giant green canes, branchless for 20 or 30 feet. At every foot or two there occurs a joint, like the joints on a tall grass, and, like the grass, the lengths between the joints—the internodes—are hollow. Each encloses a dead air space, so completely shutting it in that, if you heat the air by throwing a cane into the fire, it will explode with a loud report.

The charm of a bamboo grove lies in the friendly mystery of its shade, with the green sunlight flickering through the thin plumes of leaves on to the soft mat of yellow dead leaves below. You wander through such a grove, feeling that you have never seen anything like it before, and the quiet, fairy-like charm of it remains with you long after you have gone away.

As a landscape unit alone, therefore, a grove of bamboos is worthy of the widest popularity, and parks and open places through the south should plant them. I can imagine no more wonderful a place for little children to play in than a bamboo grove.

But there are other and more practical reasons for the widest possible distribution of the bamboo throughout the south. To begin with, its young shoots furnish one of the most delicious of early vegetables. In Japan and China it plays a loading rôle among spring vegetables, and one finds it on the tables of the well-to-do Americans and Europeans everywhere, as well as on the Japanese menus. Properly cooked, it has a freshness and flavor which always reminds me remotely of sweet corn, but its texture is firmer than almost any other vegetable I am familiar with. It comes into the market in April and, being a good shipepr, it should quickly win its proper place on the American menu, where early vegetables are always a desideratum. In Japan, the edible bamboo growers make good money out of the sale of the shoots—in fact, bamboo culture ranks as one of the most profitable vegetable industries of the country. I have eaten American-grown bamboo shoots, and those of my friends who have done so have, without exception, liked them extremely well.

To speak of the timber uses of the bamboo is a good deal like speaking of the timber uses of the pine, except that the qualities of the two are entirely distinct. The peculiar properties of the bamboo come from the fact that the trunks are composed of short, hollow cylinders, making them the lightest timbers for their strength of any known. The fibers run from end to end, making it possible to split a bamboo pole into strands or strips more easily than any other wood. These fibers are among the strongest, most elastic known, and it is the bewilderment of Occidentals visiting Japan to see how many are the uses of this peculiar timber.

For ladders, their lightness and strength render the poles remarkably well adapted; there are no fruit-picking ladders which compare with them. For fishing poles, the small canes are

THE DARK MYSTERY OF THE BAMBOO GROVE

Had Maxfield Parrish lived among the bamboo forests of Japan or China, he would have found in them the themes for many of his paintings which appeal to our imaginations by their sense of mystery. In this photograph the bamboos are nearly as tall as the pecan trees standing in their midst. (Fig. 3.)

A DOORYARD SHADED BY BAMBOOS

Oriental babies have played for fifty centuries in such cool, shaded, leaf-carpeted spots as this, but to American children they are practically unknown. In addition to the pleasure and fascination of such a grove, there is an education in the uses to which the twigs, hollow stems, and leaf-sheaths can be put by children. (Fig. 4.

imported by the millions from Japan and scattered by jobbers all over the country so that every boy can have one, and the split bamboo fishing poles, of which we use nearly $5,000,000 worth every year, are made from the outer layers of wood of the best canes. What baskets can compare in their variety and delicacy of construction with the bamboo baskets of Japan! For watering pipes for small gardens they will have the same use in America that they have in Japan, the joints being broken out with a long iron rod. Our best flower stakes are bamboo. Bamboo bean poles cannot be excelled, and for light arbors, fences, trellises, vine stakes, penholders, pipe stems, kindling wood, spraying nozzle holders, and many kinds of tool handles, they find a wide use in the Orient.

Anyone who has used a bamboo handled broom will appreciate its lightness and the smooth finish of its surface, while the split strands of bamboo are so stiff and elastic that they have been used most successfully in broom making—they may even compete with the broomcorn straw for broom manufacture.

While these are a few of the obvious uses which will probably be first investigated by Americans, it is inconceivable that the ingenuity of the American will not find new uses for so unique a raw product as the bamboo, and the Barbour Lathrop grove will play a most important rôle in the education of the people of this continent in the uses and beauty of this remarkable plant.

So far as can be ascertained, the original plants from which this grove sprang were brought into America by Mr. Andreas E. Moynelo, a Cuban by birth, who was at one time one of the largest rice planters on the coast of Georgia. Mr. Moynelo traveled in the Orient and is said to have brought the plant back with him from the East Indies, but from what particular region is unknown. The importation took place probably in the late eighties. The first planting was made several miles distant from this grove, at the village of Burroughs, and from it, probably within a few years of the time of its first planting, a small plant was taken by Mrs. H. J. Miller and set out near the well back of the house. This was in 1890, so that the grove today is twenty-nine years old. Although called an East Indian species, it appears to be very closely related to the best of the Japanese timber bamboos (*Phyllostachys bambusoides*), from which it seems to differ in no reliable character. It appears highly probable that Mr. Moynelo got his plants in Japan or China.

An Exposition of "The New Psychology"

THE CHILD'S UNCONSCIOUS MIND, by Wilfrid Lay, Ph.D. Pp. 329. Price, $2. New York City: Dodd, Mead & Co., 1919.

The type of analytical psychology which is usually associated with the name of Freud serves as a useful corrective to exaggerated claims of inheritance of mental traits; but some of its exponents show little realization of the facts of heredity. Thus Dr. Lay, whose ill-written book contains a good deal of interesting material, recalls that "the actual nervous constitution, which is determined for the child before the hour of birth, is the inheritance of an infinite number of ancestors, all of whom contribute an approximately equal part." It would be difficult to frame a more misleading sentence on the subject. Again, he "is impressed with the tremendous unity of nature, everything except man apparently completely fulfilling its appointed function all the time without interruption." The apparently imperfect things in nature are "as perfect as their environment allows them to be;" and "is not the most bestial human the best product that his circumstances could make of him?" As Dr. Lay has a good many suggestive ideas on education, it is a pity that his book could not be marked by a sounder biological point of view.

BIOLOGY AND GOVERNMENT

Further Discussion of Alleyne Ireland's Article on Democracy and the Accepted Facts of Heredity.

O. F. Cook and Robert Carter Cook

DR. WOODS has asked for biological consideration of questions raised by Mr. Alleyne Ireland in an article entitled: "Democracy and the Accepted Facts of Heredity," in the December number of this journal. To see that theories of government need to square with biological facts is an advanced position in political philosophy. Biologists may not accept the applications proposed by Mr. Ireland, but there can be no question of the need of bringing the two fields of thought into closer relations.

That acquired or environmental characters are not inherited, that mental and moral traits are inherited, that selective or assortive mating tends in nature to preserve adaptive or advantageous characters, that progressive evolutionary changes appear as individual variations, not as mass transformations, are statements that most biologists accept, but they do not seem to afford a basis for Mr. Ireland's reactionary theory of government. The question of breeding families or classes of great, ideal rulers has a flavor at once medieval and utopian, but human interests are many-sided and need to be viewed from various angles.

The proposition that assortive mating separates the population into distinct superior and inferior groups would need to be supported by definite evidence.[1] Wild species do not divide or become bimodal in relation to characters of adaptation, probably because the non-adaptive extreme is eliminated by natural selection. The human species may not become bimodal for the opposite reason, that civilization tends to eliminate the more capable and to preserve the inferior or the mediocre, the meek who inherit the earth after the more aggressive have destroyed each other or exhausted themselves in the struggle.

The main difficulty in applying general biological facts to human interests is that people in civilized countries are no longer engaged in a struggle for existence, but endangered rather by superfluity. The primitive necessities of food, clothing and shelter are now placed within reach of all, through applications of science to agriculture and other arts. How to protect ourselves against greed, luxury and urban degeneration is the biological or eugenic problem of civilized countries. The use of alcohol is only one artificial habit that is clearly prejudicial to the race under the conditions of our present civilization. The entire system of sedentary urban existence, of education, commerce and industry, undoubtedly has a sterilizing tendency that is exerted especially upon the superior stocks. The continual drafting of the more capable elements of the population from the country to the city is a persistent and dangerous form of adverse selection, as explained in an article on "Eugenics and Agriculture," published in June, 1916, in this journal. Hence, instead of becoming bimodal or tending to separate into superior and inferior groups, as Ireland imagines, our tendency is to

[1] Mr. Ireland has here doubtless drawn upon some unpublished evidence which I have been collecting for a number of years showing that the lower elements of society are being more and more removed from the upper, presumably by the action of assortative mating. The reasons why this should take place on *a priori* grounds are extensively discussed in the final chapter of my "Influence of Monarchs," 1913.—Acting Editor.

restrict ourselves further and further toward mediocrity and inferiority.

That useful talents may appear in "lower levels of society," as Professor Conklin points out in the May number, may mean that our system fails to place good stocks under favorable conditions, or that our judgment of conditions is at fault. The need is to give special ability or usefulness a selective value, to preserve and increase the family stock, but our system works generally in the opposite direction of using up and exterminating talent as rapidly as possible. Thus there are biological problems that need to be studied from the standpoint of politics, as well as questions of government that need biological answers.

Mr. Ireland's "broadest generalization," from his investigation, "that the best governed countries were those in which the mass of the people had the least control over the administration of public affairs," indicates Germany as the shining example, although not so stated. Germany, at least, will do very well to show the advantages and the disadvantages of such a government, for certainly there was no approach to effective control of public affairs by the people. Germany was a hereditary monarchy, so that the government was in the hands of one who had not only special training as a ruler but any hereditary advantages of descent from a line of kings. More than that, the fabric of government in Germany had woven in it a fairly strict caste system, so that not only the ruler, but the governing class as well, was not selected by mere numbers. At any rate, the numbers were so well balanced that they had no disturbing effect. The Krupp works employed about 18,000 men in peace times, and the directors of the firm had 18,000 votes allowed them in the elections; the "blind God of Numbers" was propitiated.

Superficially, at least, the results attained by this system seemed all that could be desired. German cities were cleaner than English or American cities. The visitor to Germany did not see the docks of Hamburg lined with human scarecrows, or little children going barefoot in the snow, as in the streets of Liverpool. Disheveled slums like those of London or New York did not exist. The tenement population of Berlin lived in improved modern buildings, along wide, clean pavements. There were no hungry beggars or aimless people wandering about in rags. Irresponsible indigence was as strictly forbidden as other misdemeanors. Everybody had something to do, and somebody to keep him at it. Only the Kaiser could do as he pleased.

Yet all these busy Germans were discontented. They knew that their activities, and even their prosperity, were artificial and that they were intended to serve the purposes of the military caste, as pigs are fattened for the slaughter. Indeed, they often referred to themselves and to their children as "cannon-fodder," foreseeing their fate as inevitable. With a less efficient government the Germans might have been less industrious, less clean, less orderly, and less aggressive. Internal dissensions and party struggles might have been carried farther and interfered with preparations for attacking other nations. Probably a democratic Germany will not be so much governed, and devotees of efficiency may weep for the good old days of Hohenzollern power.

No doubt autocracies are the "strongest" governments, or can be made very strong in the hands of a practical and prudent clan like the Hohenzollerns. The trouble with the most benevolent autocracy, whether it be a monarchy, an oligarchy, or any system in which a single class has full authority over other classes, is that it does not stay benevolent, or humane, or practical, or prudent, but generates destructive abuses of power. Courts of monarchs are seldom frequented by wise men, but have ever been the haunts of parasitic adventurers. If monarchs seek advice from anybody, it is from military men to strengthen their armies or from financiers to increase their revenues. Dominance of a

military or priestly caste is a familiar feature of strong, centralized governments. This is not only because soldiers and priests are found useful in maintaining power, but because separate tastes tend to seek their own interests and readily serve the purposes of parasitic governments in maintaining forced control of the people.

Mr. Ireland reflects on the fact that there have been only a few hundred men recognized as really great among the thousands of millions who have lived on the earth, and that "we owe all the inspiration of religion, philosophy, music, art, and literature; all the benefactions of science, discovery, and invention to the genius of a few hundred individuals." The existence of such men certainly must not be left out of account in relation to the question of government. If it appeared that more great men were produced by centralized governments, the argument for monarchies would be strengthened on the biological side, but history shows that many of the conspicuously great men have lived and done their work in conflict with the monarchs of their time. Kings and princes do not wish to be overshadowed by any of their subjects. Neither are great individuals developed by governments that make the individual a cog in a machine, or that exalt the state in order to treat the existing order as sacred and suppress individual efforts for reform.

Germany has contributed several of the great individuals who have lived, but the great Germans appeared while the country was a fairly free though chaotic aggregation of small states. Since Germany became a very efficiently organized empire she has produced no conspicuously great or famous men. There are no Goethes, Schillers, or Humboldts in Germany today, and such personalities are not likely to develop under the kind of government Germany has had during the last fifty years.

To leave the government of a country entirely to a group of experts who could always be trusted to discharge their duties in the most competent and benevolent manner, and who were entirely incorruptible and free from dangerous ambitions, might be approved as an ideal plan, though without bringing us nearer to a practical realization. Time and again this ideal possibility has been put to the test, when governments have been taken in hand by those who had shown themselves best qualified for control. Many great men have served as kings, or as rulers of other kinds, and have organized their governments with the help of the most competent advisers, but nowhere in history has any family, clan or class been able to maintain itself permanently by capable leadership. Vanity, ambition, and greed are so general and so dominant, in human psychology, that every system of arbitrary power gravitates naturally toward oppression and parasitism. Eventually the system decays so far that revolution can put an end to it, or another party grasps the power, and the cycle is repeated.

However well an autocracy works for a time, the national interests run eventually into the narrow channels of arrogance, selfishness and stupidity of the ruling class. Forgetting that their authority was given them by man, they end by claiming supernatural power, or special relations with the Deity, beyond the reach of any restraining idea. Fear of God and regard for man alike disappear in their exalted self-assurance. The crux of the matter seems to be that the exercise of arbitrary power is essentially unjust, unsocial, immoral, and destructive to those who use it. "For somehow this malady attaches to tyranny, not to put confidence in its friends."

That a system should be strong and efficient, so that it can direct, dominate and project itself widely is the ideal of government inspired through the sense of power. Many are fascinated by the idea of one man or a small group of men seated on a pinnacle of authority, controlling the fate of millions. But we are now beginning to see that this sense of power is a primitive instinct, and is being outgrown. It is much stronger among savages or in barbarous coun-

tries than among civilized people. To know what should be done is the first qualification of constructive leadership. Fully intelligent, right-minded men no more desire to control than to be controlled. For those who are anxious to find their place in the world and to do their share of the work, external compulsion is not needed. Organization, plans, and directions that coördinate effort are understood and obeyed, but arbitrary, unnecessary orders are resented.

The sense of present-day humanity—that popular government is the best—is the product of the long experience that history records and is not in conflict with biology or with the scientific spirit. Freedom is the eldest daughter of Science, according to Thomas Jefferson, who saw very clearly that the human mind must be liberated in order to work out a higher destiny, and that this provision for progress must be a fundamental consideration in government. The Napoleonic theory that "governments are established to aid society to overcome the obstacles which impede its march" is less profound because it does not so clearly recognize the source of constructive progress in the scientific mind, and the need of excluding all forms of artificial domination and oppression of the mind, as well as the physical forms of injustice. Scientific men, even more than others, should appreciate the need of progress in government to meet changes of other kinds. Our experiment in democracy is very different from any that preceded it, in being aimed toward scientific government.

Mr. Ireland's theory of government does not appear progressive, but distinctly archaic. It is conceived, as he says, "on the level plain of routine," the object being "to direct the energy of the mass," a project like making all the clocks strike at the same instant, as in the traditional effort of another disillusioned specialist in government. Instead of looking forward to a world of capable, right-minded people, "wisdom and talent" are to be established in authority as a select class, to avoid a catastrophe that threatens the existing order through the advance of democracy.

But there would be more danger that placing a select class in control would insure its destruction in the usual way, instead of tending to preserve it. Responsible majorities are not dangerous, but irresponsible minorities, of parasites or fanatics. Where has democracy produced any such reactions as the French Revolution a century ago, or the Russian Revolution of today? What are the principles or theories that need to be applied in government, but cannot be presented and explained for the approval of a free electorate?

Not too much power in the hands of the people, but too little of active, constructive interest in problems of general welfare, even among intelligent citizens, is the most serious danger in popular government. People think of the government much as they think of an insurance company. They pay their tax assessments passively and assume that a mysterious system will attend properly to the public work. Our theories are democratic, but many of our habits are still feudal or monarchic. We are far enough from monarchy to think of the government as responsible to the people, yet not far enough for people to think of themselves as responsible for government. A special lesson on this point is now being had in Germany.

The general problem of government is to develop popular systems along lines of wider and more direct interest to the people, not to restrict interest or responsibility to a special governing class and revert to institutions of arbitrary power. The discussion of eugenics and other applications of biology no doubt will lend more constructive interest to political questions. Eventually there may be developed a truly biological conception of the race as a living organization, and of governments and other social institutions as means of conscious adaptation, to meet progressive needs in each generation.

EUGENICS, THE WAR INSTINCT AND DEMOCRACY

JOURNAL OF HEREDITY:

Certain articles that have appeared in the journal during the last five or six months have moved me to a certain amount of speculation, which I now put forward tentatively. They are merely the speculations of a layman.

In one number of the journal (which I have not at hand and cannot definitely refer to) was an article (by Woods, I believe) to the effect that war might be beneficial by aiding Nature in her problem of the survival of the fittest.[1] Does not war rather tend to take the fittest from each nation, and kill, or maim, or break them with disease, and in this way, rather than leave Nation A stronger than Nation B, leave B weaker than A, and both A and B, and hence the race, weaker than before? In the same number was an article by Popenoe which attempted to demonstrate that war is inevitable, because of an innate instinct in man for war, an hereditary instinct, an instinct which is therefore as ineradicable as one's heart or lungs. Is there not rather a desire for occupation, for a struggle for existence, which under favorable circumstances may be directed along industrial, scientific, and artistic lines, but which under unfavorable conditions may run to marauding and bloodshed? It is a notable fact, at any rate, that all of the wars in the history of civilization have been due either to the ambitions of some foolish monarch or to the commercial interests of those classes from which a monarch draws his support. Perhaps if these wars had not occurred, others would, due to the innate desire of which the author speaks; perhaps peace would have reigned; there is no telling. But supposing both or either of these theories to be correct, they seem to me, unless followed to their natural conclusion, to be rather dangerous doctrines to preach. There are four possibilities in regard to them.

1. War is neither beneficial nor inevitable, in which case we should do everything in our power to forestall the possibility of war.

2. War is beneficial but evitable. In this case one can only ask *how much* excessive war is beneficial, for certainly too much war means extinction. What scientist will draw the line between too much and enough? I scarcely think there is any. Then we take no more risks in evading war than in indulging in it—for how can we tell that we do not indulge too much? And war is a different thing to control, anyway—once it gets started there is no saying how far it will go. A well-directed system of executions would be much safer. So the same thing to do in this case, of course, would be to look to our present weal as we cannot look to our future and forestall any possibility of war.

3. War is detrimental but inevitable. If this be true we can only remove all superficial causes of war, and for the rest either resign ourselves or shake our fists at the Unknowable, as our natures or religions dictate.

4. War is beneficial and inevitable. In this event, war is a result of natural law, and, as a result of natural law, is beneficial. But it no less surely follows that any war that is not the result of natural law, but the result of super-

[1] The article is by Alleyne Ireland in the November number, 1918. It concerns a quotation from "Is War Diminishing?" by Woods and Baltzly. The contention, however, was never made by these authors that war is eugenic. Woods pointed out some possible eugenic aspects of war that were ignored by partisan writers and by the then numerous pacifists. The disgenic aspects of war are also here considered, and the contention is made that further researches are necessary. —ACTING EDITOR.

ficial causes (the commercial interests of a few, the whims of a monarch) is not beneficial; for it goes without saying that the desire of a few obsessed mammon-worshipers does not represent the innate instinct of the mass. Only such war as is inevitable is beneficial, for again too much war will surely lead to extinction. It then follows that we should remove all superficial causes of war and only indulge in such wars as are dictated by nature, *i. e.*, by the desire of the people of a given nation *as shown by a popular vote*. By this method and by this method only can we evade interference with nature.

Hence it follows that whether neither, either, or both of the postulates that war is beneficial and that war is inevitable are true, our course of action should be the same—to forestall the possibility of war in every way.

The other bone I have to pick is Ireland's article in the December number: "Democracy and the Accepted Facts of Heredity." Ireland makes the point that some people by their intellectual heritage are more fit to govern than others, and that these individuals should be given something of a free rein in governing. If these people would govern for the good of their nation at large, and not for the good of themselves and their small cliques of supporters, this would be true enough. But although certain men have the intellectual ability to govern efficiently, I dare say that not one in a century has sufficient moral strength to govern justly if he is not held in check by the chances of dethronement. I do not hold up popular control as the panacea of all evils, but it is likely to exert a restraining influence on the ambitious. It is a historical fact, of course, in practically every country, that social and economic reforms (decent housing conditions, living wages, etc.) have not come from the governing classes, but from and because of the demands and unrest of the masses. And while I do not support any religious dogma, I do hold that every man has a right to a square deal. Moreover, I hold that war is, to all intents and purposes the offspring of a government by (and therefore for) the few. If war had only been declared after a popular vote had shown a people in favor of it, I venture to say that there would have been very few wars in history.[2] And I venture to say that the individual nation and the world at large would be no worse off if this custom prevailed. The German and Russian workers and peasants would scarcely have been sufficiently interested in the jealousies of their masters to have started the holocaust that has just terminated. As to Mr. Ireland's fear for the fate of the individual, such individuals as Napoleon, the late Kaiser, or Bismarck would doubtless feel themselves hampered by a democratic government. And it is unfortunately to Napoleonism and Bismarckism that brilliant minds run when given unlimited power. As far as the arts and sciences go, I think Mr. Ireland can safely put away his fears. When even such a radically popular government as the one at Moscow puts such a man as Lunacharsky at the head of its educational system it does not point to a disapproval of personal genius. Even Trotsky would scarcely advocate that pictures be painted by referendum or that esthetic criticism be put upon a communistic basis. Moreover, even though Mr. Ireland may not consider the ten million odd of the *hoi polloi* killed in the recent war—precipitated by autocratic governments—to be important, still he must admit by his own argument that the death of such men as Gaudier-Brzeska, Rupert Brooke, Peguy, Frakl, etc., were a genuine and irremediable loss to civilization, provided, of course, that he has ever heard of these men. And no one knows how many potential Shakespeares and Newtons there were among the nineteen and twenty-year-olds that were slaughtered and broken.

The chief crime of democracy would seem, then, to be a relative inefficiency in the handling of public affairs, of

[2] This should be decided by a systematic appeal to the facts of history. Some facts as yet unpublished indicate that democracies are quite as prone to war as are autocracies.

autocracy, selfishness, which results in war, slaughter, disease, and the degeneration of mankind.

There is also the esthetic argument for democracy which I shall at present refrain from expounding, as Mr. Ireland would doubtless consider it a sort of fourth-dimension vaporing. It is, notwithstanding, responsible for the opinions of a considerable portion of the world's population.

I repeat, however, that I offer these opinions not as the opinions of an expert, but as the opinions of a layman. It is only because I suspect that a great many other laymen may hold them that I trouble you with them. But this being the case, I think it would be worth while for your experts to set me and my comrades in ignorance right on these matters if we are wrong. For such, I take it, is the social function of experts.

Very truly yours,

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A FACTOR INFLUENCING THE SEX-RATIO

During the latter part of the nineteenth century it was generally believed that sex in man and in various animals is determined mainly by the amount of nourishment that the embryos receive; well-nourished embryos were supposed to become females; those that were poorly nourished were assumed to develop into males. A considerable amount of evidence in favor of this view was collected by Düsing ('83, '84, '86), who maintained, furthermore, that close inbreeding interferes with embryonic nutrition, by lessening the vitality of the mother, and so produces a great excess of male young.

Helen Dean King has recently reported some results of the effect of inbreeding upon the production of male or female offspring among albino rats. Her conclusions in part are as follows:[1]

In each series the difference between the sex ratio for the group of inbred litters and that for the group of half-inbred litters is a significant one. Apparently, therefore, the chemotactic reaction between the ovum and the spermatozoön is not quite the same where these sexual elements come from unrelated individuals as when they are produced by individuals that are closely inbred.

Morgan ('14) has suggested that the infertility of the eggs of Ciona to spermatozoa from the same individual may be due to the similarity in the hereditary complex of the germ cells, which in some way decreases the chances of their uniting. The selective fertilization experiments made by Marshall ('10) with different varieties of dogs and also my own experiments with different varieties of rats show that the ova of these animals have a strong tendency to unite with spermatozoa from individuals belonging to unrelated stock rather than with spermatozoa from individuals of the same blood.

The results of this series of experiments, as a whole, seem to indicate that in the rat, as in the pigeon (Riddle, '14, '16, '17), in Drosophila (Moenkhaus, '11) and in the guinea-pig (Papanicolau, '15), the female has more influence in determining the sex ratio than has the male. Yet it is not in the differentiation of the ova, nor in the development of the spermatozoa, that the key to the riddle of sex-determination will be found. A knowledge of the interaction of the germ cells, and of the conditions that influence it, must be gained before the final solution of this problem can be attained.

[1] Helen Dean King. Studies on Inbreeding—III. The effects of inbreeding, with selection on the sex ratio of the albino rat. *Journal of Experimental Zoölogy*, vol. 27, No. 1.

THE FOUNDERS OF THE ART OF BREEDING—IV

Pre-Mendelian Breeders of the Nineteenth Century—*Concluded*

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DURING the time of the prosecution of the work of Knight and Herbert appeared the results in hybridization obtained by Sageret in France. Sageret's experiments in crossing were largely confined to the Cucurbitaceae, and his results were published in a memoir entitled, "*Considérations sur la production des hybrides, des variantes et des variétés en général, et sur celles de la famille des Cucurbitacées en particulier,*" which appeared in 1826 in the *Annales des Sciences Naturelles*, Vol. 18.

SAGERET ON SEGREGATION

Sageret made some discoveries that clearly anticipate our modern knowledge of segregation, and he was able to furnish what was, for the time, a fairly satisfactory scientific explanation for the reappearance of ancestral characters. The experiment upon which his conclusions were primarily based was a cross in which a muskmelon was the female and a cantaloupe the male parent. Each plant was regarded as a relatively pure or type representative of its kind. In stating the results of the cross, Sageret for the first time, so far as the writer knows, in the history of plant hybridization, aligned the characters of the parents in opposing or contrasting pairs after Mendel's fashion forty years later. Following is the list of contrasting parental characters as Sageret gives them:

Muskmelon (female)

1. Flesh white.
2. Seeds white.
3. Skin smooth.
4. Ribs slightly evident.
5. Flavor sugary, and very acid at the same time.

Cantaloupe (male)

1. Flesh yellow.
2. Seeds yellow.
3. Skin netted.
4. Ribs strongly pronounced.
5. Flavor sweet.

Sageret remarks: "The assumed product of the crosses made ought to have been intermediate: (1) Flesh very pale yellow, (2) seeds very pale yellow, (3) netting light, (4) sides slightly marked, (5) flavor at once sweet and sprightly, but the contrary was the case."

As a matter of fact, in the two hybrid fruits reported upon, *the characters were not blended or intermediate at all, but were clearly and distinctly those of the one or the other parent.*

First hybrid	*Second hybrid*
1. Flesh yellow.	1. Flesh yellowish.
2. Seeds white.	2. Seeds white.
3. Skin netted.	3. Skin smooth.
4. Ribs rather pronounced.	4. Ribs wanting.
5. Flavor acid.	5. Flavor sweet.

In the further support of his conclusions regarding the descent of characters in unitary fashion, he remarks upon the inheritance of human hair and eye color in the mating of a brunette with a blonde type. He comments upon the fact that these two hybrids are types of which he had "several times obtained the analogues or their equivalents." While there is fusion here and there, he says, "one sees here a much more marked distribution of their different characters, without any mixture between them." He even uses, for the first time in the literature of plant hybridization, the word "dominate" with reference to characters in crossing, in the following words. Speaking of the inheritance of flavor in various melon crosses, he says:

"The acid flavor of the muskmelon is encountered in the forms of the cantaloupe and the snake-melon; in others, the form of the cantaloupe dominated."

Summing up the results of his experiments in a general conclusion, he says, with regard to the natural expectation that in a hybrid there will be a complete or partial fusion of the parental characters, that "this fusion of characters may take place in certain cases; but it has appeared to me that, in general, things did not take place in this way;" and again: "It has appeared to me that, in general, the resemblance of the hybrid to its two ascendants consisted, not in an intimate fusion of the diverse characters peculiar to each one of them in particular, but rather in a distribution, equal or unequal, of the *same characters*." (Italics inserted.)

Here we meet again, for the first time in the literature of hybridization, the phrase "distribution of characters" now so familiar. "These facts," Sageret remarks, "have been confirmed by a multitude of my experiments." It is evident from the following statement that Sageret appraised his discovery of the dominance of characters in crossing at its proper value: "The ideas which I present," he says, "have appeared remarkable to me; they seem to me to be of a very great importance."

In addition to his melon crosses, Sageret secured a hybrid between a black radish and a cabbage, of which he says: "The fruits, instead of being intermediate, were like either cabbage or radish on the same inflorescence. Each silique bore a single seed, analogous to its pod," to which he makes reference in a further comment upon "*the distribution among hybrids, of the characters of their ascendants without fusion of these characters*," a point of view with regard to the results of hybridization that needs little to make it modern. It is, however, a matter of further interest that Sageret was able to derive the natural scientific conclusion from the facts of unit-character inheritance as he found them, with respect to the reappearance of old or the appearance of new "species." The hybrids "often reproduced for me," he says, "varieties which had long ago disappeared."

He finally concludes: "To what, then, does this faculty belong, which nature has, of reproducing upon the descendants such or such a character which had belonged to their ancestors? We do not know. We are able, however, to suspect that it depends upon a type, upon a primitive mould, which contains the germ which sleeps and awakens, which develops or not according to circumstances, and possibly that which we call a new species, in which develop organs, ancient but forgotten, of which the germ existed, but which the development had not yet favored."

DARWIN ON HYBRIDS

On November 24, 1859, appeared the first edition of Darwin's epoch-making book, "The Origin of Species," in which he briefly reviewed (Chap. 9) the results and conclusions regarding hybrids and hybridization up to his time. In reading Darwin's chapter one is strangely struck by the persistence of the species-variety question.

Is this a "species," or is it merely a "variety?"—a question which crossing was expected to answer. If two organisms would not cross, or if their offspring were sterile, they were thereby proved to be distinct "species." If they freely intercrossed, or if their offspring were fertile, then, *ipso facto*, they were "varieties" of the same species. Darwin's thesis—that "species," so called, grew out of "varieties" so called, by natural selection, caused him to review the evidence which the work of the hybridists, especially Koelreuter, Gartner and Herbert, afforded. Regarding the matter of the relation of hybrids to species-affinity, Darwin writes with his usual conservative wisdom:

"No one has been able to point out what kind or what amount of difference, in any recognizable character, is sufficient to prevent two species crossing. It can be shown that plants most widely different in habit and general appearance, and having strongly marked differences in every part of the flower, even in the pollen, in the fruit and in the

cotyledons, can be crossed . . . (p. 14). The facility of making a first cross, between any two species is not always governed by their systematic affinity or degree of resemblance to each other. This latter statement is clearly proved by the difference in the result of reciprocal crosses between the same two species, for according as the one species or the other is used as the father or the mother, there is generally some difference, and occasionally the widest possible difference, in the facility of effecting an union. The hybrids, moreover, produced from reciprocal crosses often differ in fertility" (p. 16).

Again he says: "There is often the widest possible difference in the facility of making reciprocal crosses. Such cases are highly important, for they prove that the capacity in any two species to cross is often completely independent of their systematic affinity, that is, of any difference in their structure or constitution, excepting in their reproductive systems (p. 14). It can thus be shown that neither sterility nor fertility affords any certain distinction between species and varieties. The evidence from this source graduates away, and is doubtful in the same degree as is the evidence derived from other constitutional and structural differences" (p. 4).

Darwin finally summarizes the evidence as follows: "First crosses between forms, sufficiently distinct to be marked as species, and their hybrids, are very generally, but not universally sterile. The sterility is of all degrees and is often so slight that the most careful experimentalists have arrived at diametrically opposite conclusions in ranking forms by this test" (p. 44).

In 1861 the Paris Academy of the Sciences proposed the following problem to receive the grand prize in the physical sciences: "To study plant hybrids from the point of view of their fecundity, and of the perpetuity or non-perpetuity of their characters. "The production of hybrids among plants of different species of the same genus is a fact determined a long time since, but many precise researches still remain to be made in order to solve the following questions, which have an interest equally from the point of view of general physiology, and of the determination of the limits of species, of the extent of their variations.

"1. In what cases of hybrids are they self-fertile? Does this fecundity of hybrids stand in relation to the external resemblances of the species from which they come, or does it testify to a special affinity from the point of view of fertilization, as has been remarked regarding the ease of production of the hybrids themselves?

"2. Do self-sterile hybrids always owe their stability to the imperfection of the pollen? Are the pistil and the ovules always susceptible of being fecundated by a foreign pollen, properly selected? Is an appreciable imperfect condition sometimes observed in the pistil and the ovules?

"3. Do hybrids which reproduce themselves by their own fecundation sometimes preserve invariable characters for several generations, and are they able to become the type of constant races, or do they always return, on the contrary, to the forms of their ancestors after several generations, as recent observations seem to indicate?

THE IDEAS OF GODRON

The two chief competitors under the Academy's offer were Charles Naudin of the Museum of Natural History at Paris, and D. A. Godron of the University at Nancy, the prize being awarded to the former. The papers of both appeared in Vol. 19 of the *Annales des Sciences Naturelles* (Botanique), 4 me. Serie (1863).

The title of Godron's thesis was "*Des hybrides végétaux, considérées au point de vue de leur fécondité et de la perpetuité ou non-perpetuité de leurs charactéres.*" His paper is chiefly devoted to the solution of the question as to whether "hybrids reproducing by self-fertilization sometimes keep their characters invariable during several generations, and whether they are able to become the types of constant races, or whether, on the contrary, they always return to the forms of one of their

ancestors at the end of several generations, as recent observations seem to indicate. In answer to this query, he says: "We have determined, upon hybrids of *Linaria*, that the hybrid forms may become very fertile, and that a certain number of individuals, from the second generation, return respectively to the two primitive types, when they grow in company with their parents, and this return movement manifests itself much more in the following generations."

Godron remarks that the same fact has been observed by Lecoq in the fertile hybrids of stocks, by Naudin in the fertile hybrids of tobacco, and by several observers in primula and in petunia. From these experiments, then, he concludes the proof of the final return of fertile hybrids to their parental forms to be established. Godron was a victim of the rigid idea of species, which held, that because so many hybrids between different "species," so called, were sterile, that therefore any hybrid which proved fertile must necessarily, *ipso facto*, prove the parents not to be of different species but to be merely varieties of the same species.

To the vain purpose of settling this verbal controversy, as to whether such and such plants were to be regarded as separate "species," or merely as varieties of the same species, many of the most ardent endeavors of hybridists, both before and since Mendel's time, have been conscientiously and duly devoted. A sample of this method of reasoning in a circle so vigorously combated by Herbert, and characterized by Sageret as "fighting the air," is exemplified in a sentence of Godron which typifies the then general view. He says: "*To admit that two distinct species have produced hybrids which, from the very first have become very fertile, would constitute a very grave exception to the law* which has its sanction in the numerous experiments which, for a century past, have been made by Koelreuter, Wiegmann, C. F. Gartner, etc., and by M. Naudin himself, *that simple hybrids are sterile or but little fertile.*" (Italics inserted.)

Considering the fact, however, that hybrids between confessedly distinct species are so frequently sterile, it is not surprising that, in view of the then greater interest in the species question itself, that hybridizers should have turned systematic botanists and have made the sterility of the hybrid offspring a criterion of species distinction. Besides his competing memoir before the Paris Academy, Godron was the author of several other contributions to the literature of plant hybridization, including that of the then celebrated question as to the possible origin of cultivated wheat from the wild plant *Aegilops ovata*.

NAUDIN'S CONCLUSIONS

The general conclusions of importance for his time, at which Naudin arrived, are as follows—in the language of the award committee of the Academy—and which are quoted in their own words (6c) to show the point of view of science at that time: "The first, and the most important of all, is that the singular beings which result from the cross-fertilization of two different types, far from being condemned to absolute sterility, are frequently endowed with the faculty of producing seeds capable of germination" (p. 129).

"The second consequence of major interest which proceeds from the numerous experiments in the same memoir is *that fertile hybrids have a manifest tendency to return to the forms that produced them, and that without other action than that of their own proper pollen, under such conditions that the pollen of the parents is not able to exercise the influence to determine this return*" (p. 129).

UNIT CHARACTERS

An essential feature in Naudin's paper, of high importance from our present standpoint, is the independent behavior of characters in a cross, and referred to by the Academy committee as follows: "Not content with responding by numerous experiments to the questions propounded by the Academy, the author . . . has sought to throw light upon several points, some obscure, others not yet studied, in the

history of hybrids. He has confirmed that which Sageret already knew, that in a hybrid the characters of the two parents are often shown, not blended but approximated, in such fashion that the fruit of a *Datura* hybrid, born of two species, the one with a smooth, the other with a spiny capsule, *presents smooth places in the midst of a surface generally spiny*. This disjunction, as it is called, is explained according to him by the presence in the hybrid of two specific essences, which tend to be separated more or less rapidly the one from the other. He even sees in this disjunction the true cause of the return of fertile hybrids to the types from which they came" (p. 131). (Italics inserted.)

It is further of great interest to note that the seeds gathered from the smooth side of the capsule reproduced only the smooth-capsule form, *Datura laevis*, while those taken from the spiny side gave rise only to the spiny form, *Datura stramonium*. In Verlot's paper, yet to be discussed, further instances of this vegetative segregation, as it may be called, will be found.

Naudin stated, more clearly and definitely than others had hitherto done, the fact of the general uniformity of the hybrid offspring of the first generation (the F_1 generation), as we should say, and the diversity of form, with partial reversion to, or, as we would now put it, the reappearance of, the parental types in the second hybrid (or F_2 generation). His language is as follows: "Finally, one may say that the hybrids of the same cross resemble one another in the first generation as much, or almost as much, as the individuals which come from a single legitimate species."

In contradiction to the results derived by Sageret from his particular set of experiments, Naudin asserts the generally intermediate nature of the first generation hybrids: "All the hybridologists are in accord in recognizing that the hybrids (and it is always the question of the hybrids of the first generation) are mixed forms, intermediate between those of the two parent species. This is, in fact, what takes place in the immense majority of cases; but it does not follow therefrom that these intermediate forms are always at an equal distance from that of the two species." He goes on to remark upon the vagueness with which this relative approximation is determined, resting as it does, largely upon a basis of opinion. He also calls attention to the fact that sometimes the hybrids resemble one of the two parents in certain parts and the other in other parts. Regarding segregation in the second hybrid generation he says: "Very often, to the so perfect uniformity of the first generation, there succeeds an extreme medley of forms, some approaching the specific type of the father, the others that of the mother . . . It is, as a matter of fact, in the second generation that this dissolution of the hybrid forms commences in the great majority of cases. . . . Among several of these hybrids of the second generation, there is a complete return to one or the other of the two parental species, or both, and diverse degrees of approach to these species."

NAUDIN'S EXPLANATION

Naudin now comes to what he regards as the philosophical explanation of these facts: "All these facts are naturally explained by the disjunction of the two specific essences, in the pollen and in the ovules of the hybrid. A hybrid plant is an individual in which are found united two different essences, having their respective modes of development and final direction, which mutually counter one another, and which are incessantly in a struggle to disengage themselves from one another." "The hybrid," he says, "in this hypothesis would be a living mosaic, in which the eye would not discern the discordant elements as long as they remained intermingled; but, if in consequence of their affinities, the elements of the same species mutually approximating one another, agglomerate in rather considerable masses, there may result therefrom parts discernible to the eye, sometimes entire organs, etc."

Naudin concludes that the pollen and the ovules, and the pollen especially,

"are the parts of the plant where the specific disjunction takes place with the most energy." He goes on to suppose, and here, perhaps he comes closest to a statement of Mendel's view, "that in the hybrids of the first generation the disjunction takes place at the same time in the anther and in the contents of the ovary; that some of the grains of pollen belong totally to the species of the father, and others to the species of the mother; that in others the disjunction has not occurred or has just commenced; let us grant again that the ovules are, in the same degree, segregated toward the side of the father and toward the side of the mother. . . . If the tube from a grain of pollen, approximated to the species of the male parent, encounters an ovule segregated in the same direction, there will be produced a plant entirely reverted to the paternal species. The same combination being accomplished between a grain of pollen and an ovule, both segregated in the direction of the female parent of the hybrid, the product will return in the same way to the species of the latter; if, on the contrary, the combination is effected between an ovule and a grain of pollen segregated in a direction contrary the one to the other, there will result a true cross-fertilization like that which has given birth to the hybrid itself, and there will result therefrom a form intermediate between the two specific types."

In 1864 Naudin communicated a second report to the Academy, in which he confirmed his previous results as to uniformity in the first generation crosses, the identity of reciprocal crosses, and the "disorderly variation," as he calls it, of the hybrids of the second and succeeding generation. In neither of the two papers is there any numerical classification of the hybrid types.

Naudin's memoir is often referred to as amounting virtually to a statement of Mendel's law of the disjunction of hybrids. In Naudin's case, however, the statement was of a speculative nature and consisted in the proposition of a scientific hypothesis; in Mendel's case, his "law" was a scientific conclusion derived as the result of experiment. Naudin propounded, in 1863, a well-reasoned theory of probable truth; Mendel, in 1868, formulated a statement of ascertained fact.

THE WORK OF VERLOT

In 1865 B. Verlot, of the Jardin des Plantes at Paris, published a brief memoir which in 1862 had received a prize from the Imperial and Central Horticultural Society, the thesis of which was as follows: "To demonstrate the circumstances which determine the production and fixation of varieties in ornamental plants." The memoir is of interest as thoroughly and typically embodying the general point of view of the day concerning hybridization and the origin of new varieties, while affording at the same time much matter of interest from the standpoint of practical horticulture. Verlot presented the view that, while the causes of variation are unknown, they arise under definable circumstances, chief among which he enumerates prolonged cultivation, removal from one set of climatic and soil conditions to another, and hybridization.

The thought of the time did not clearly distinguish a difference between the nature of the changes brought about by the external environment and those arising from sexual fertilization. Both were generally assumed to be equally heritable. Cultivation long continued was considered to have been especially potent in bringing about variation. In Verlot's words: "It is especially with plants cultivated for a great number of years, with those the introduction of which is so ancient that it is lost in the night of time, that one finds profound and multiplied modifications" (p. 4).

He further voices the then prevailing view regarding the relation between culture and variation: "If we compare," he says, "a species in its spontaneous condition with the same species cultivated, transported, that is to say, most often into conditions of climate, soil, etc., completely different from those where it lived before, we shall be struck by seeing that in our gardens this latter will show deviations of type more numerous than in the wild state. We

shall derive from this fact the consequence that the faculty of varying, which is proper to the plant, augments with culture. If we observe, then, that the plants cultivated in our gardens which have varied the most—as, for example, the dahlias, the roses, the camellias, the rhododendrons, the potato, etc.—are not borrowed for the most part from our flora, nor from one of the neighboring floras, but on the contrary come from distant countries, where they grow under conditions often absolutely different from those in which we cultivate them, we shall conclude that the more a species is depatriated the more it will easily vary" (p. 30); and again: "The more plants are cultivated, the greater their variations are, and, by the same token, the easier they are to fix. We will possibly be contradicted, but we do not hesitate to consider, once more, long-practiced culture as one of the most favorable antecedents to the rapid fixation of variations" (p. 38).

We now know at least that the increased variation manifested by wild plants, when brought into cultivation, is probably due to the removal of the restrictive influences of competition rather than to any actual increase in the range of heritable variability itself.

Verlot cites, as examples of the changes supposedly wrought by culture, the changes brought about in the roots of such plants as beet and parsnip, in the production of dwarf plants, in various modifications in general habit, such as fastigiate, pyramidal and weeping variations in trees; in the appearance of variations with laciniate or otherwise modified leaves; in varieties with leaves colored white, yellow, red or brown; in the arrangement of the leaves, as in the sudden appearance on an ordinary alternate-leaved plant of *Rosa alba*, of a shoot with opposite leaves, propagated as *Rosa cannabifolia*. From the evidence he concludes that cultivation sets up within the plant a condition of instability, which gives rise not only to seed variation but to variation within the plant itself—what we would call bud-variation or somatic segregation—as in the case just cited, the case of a chrysanthemum reported which bore at the same time yellow and rose-colored flowers, and of a citrus fruit half-and-half orange and lemon. Another case cited by Verlot is that of a variegated *Camellia imperialis* which, for twelve years, had constantly given brilliant white flowers set off with rose-colored striations and variegations, and upon which a small branch appeared one year bearing three flowers, in a group of a uniform rose color, the same in tint as that of the striations and variegations of the other flowers.

"It is evident, in these cases," says Verlot, "that the colorations disjoin and that this variation returns by disjunction to its colored types, as we have indicated for certain plants of hybrid origin. (p. 67). As we see," he says, "by the sole fact that a plant is cultivated, it is forced to vary. The instability of a cultivated plant is even evident in certain cases in such a way that it does not only manifest itself in the direct descendants of the plant, but also in the plant itself. Thus, while the generality of the branches of a plant bear leaves, flowers and fruits of definite forms or colors, a branch is sometimes produced in which the leaves, flowers, and fruits present completely different characters. We recognize that culture has been and is still the essential cause of the variation of plants, and that thereby man has, so to speak, compelled them to re-clothe themselves with new forms appropriate to his needs or to his caprices" (p. 5).

The above statement excellently presents the older point of view regarding variation. Such cases as the rose, chrysanthemum and orange, and the famous hybrid *Cytisus Adami* (*purpureus* $\times$ *laburnum*), Verlot accounts for under the guise of Naudin's conception of "disjunction": "It is by disjunction that, in these last cases, the specific forms thus reappear in hybrid plants, and it is with woody plants, it will be noticed, that this fact presents itself; individuals, that is to say, which, persisting for long years, must achieve all the phases of existence of a hybrid plant,

an existence of which this disjunction would be the last term" (p. 14). He then refers to Naudin's case of disjunction in *Datura*, which is elsewhere discussed. Verlot's expression of views on the matter of methods of selection is so thoroughly typical of the thought of his time, *i. e.*, that variation is in consequence of the "breaking up" of the "type," and that selection, *ipso facto*, intensifies the variation in the direction selected for, that it is a matter of interest to present here the view expressed. "If a variation is produced in a direction other than that toward which one tends, it ought not to be abandoned for that; one will have more chance of obtaining new variations in sowing a deviation from the type, even in a diametrically opposite direction, than in sowing anew the type itself. In the deviation there is already a tendency toward perturbation, and toward the beginning of the destruction of atavism" (p. 31).

Another interesting example of the older empirical point of view regarding plant improvement is Vilmorin's opinion, quoted by Verlot, and which is here reproduced to show how thoroughly the primary idea of "breaking up the type" in order to bring about "variation" entered into the thought and operations of pre-Mendelian breeders.

"To obtain from a plant not yet modified, varieties of a kind determined in advance, I will first set myself to making it vary in some direction or other, choosing for the reproducing factor, not that one of the accidental varieties which would most nearly approach the form which I have proposed to myself to obtain but simply that which would most differ from the type. In the second generation, the same care would make me choose a deviation, the greatest possible at first, the one most different, in a word, from that which I would have chosen in the first place. Following this direction for several generations, there necessarily ought to result, in the products obtained, an extreme tendency to vary; there then results again, and that is the principal point according to me, that the force of atavism, exerting itself counter to very divergent influences, will have lost a great part of its power, or, if one ventures to make use of this comparison, it will exert it always in a broken line" (p. 28).

Man's relation to the fixation of characters in new races of plants is stated by Verlot in the usual manner prevalent in the days before Mendelian analyses: "In brief, gardeners have remarked with reason that a plant newly introduced is very susceptible to vary. This fact, it is conceived, has nothing surprising about it. It confirms that which we have previously said, that a variety, whatever it might be, had need, in order to become fixed, of being cultivated for a greater or less length of time, until one had finally come to maintain with it the tendency not to depart from being that which he had made it" (p. 70).

In other words, the idea then prevalent, and more or less incoherently expressed, was that, in some unknown manner, man, by continued selection, succeeds in impressing upon a "variety" the stamp of a certain type, and, through repeated and continuous selection in the same direction, finally "fixes" it, so that the variety becomes, as it were, stabilized. Analyzed in a modern way, it simply means that, by continuous selection of some certain type, those individuals are usually isolated which are homozygous for the character-units thus represented, and which become "fixed," because no heterozygous factors are left to split apart.

We have here, in other words, an unscientific sensing through practical experience of the fact which the breeder of today would define as the selection of a heterozygote having dominant characters differing from those of the species. Being of hybrid nature, such a plant would break up and hence yield new types, whereas the plants resembling the type are more apt to be homozygous and less liable to vary in their progeny. He emphasizes the view just set forth still more emphatically in the following words: "If two variations are produced, of which the one differs little

from the type, but is placed upon the line which leads in the desired direction, and the other is placed in an opposite direction, but departing considerably from the type, we shall not neglect nevertheless to follow this latter, because with it the breaking-up of atavism is more advanced" (p. 31).

The necessity of fixing upon some single individual plant as the basis of selection is referred to by Verlot in the following terms: "We ought, then, to recognize that it is necessary to take account for the choice of the seed-bearers, not only of the external characters but even of the idiosyncrasy of each one of them. Now since this does not manifest itself except by its effects, we shall, if a variation seems to present some difficulties in becoming fixed, have to examine separately the products of each of the seed parents and make our choice bear upon those which present, in the least pronounced degree, atavism, or the tendency to return to the primitive type" (p. 32).

Verlot's experience with and observations upon hybrid plants, as coming from an experienced horticulturist, are interesting, and, to the practical plant breeder, valuable. Regarding the now well-understood fact of the gradual disappearance of the hybrid forms through segregation, he says: "Their fertility is of short duration, through the more or less rapid return of their products to the types which have given them birth" (p. 25).

Regarding the general aspects of plant hybrids, he adds: "All their characters, of whatever nature they may be, with the exception of a more considerable development of the organs of vegetation, are, in general, intermediate between those of the parents, but always limited by them" (p. 25). Regarding the matter of the bounds or limits of the hybrid characters he remarks elsewhere: "Let us call attention to a circumstance always constant in the hybrids, which we have to consider, that is, the absence in the products of colors other than those, or a combination of those of the parents. We shall insist upon this characteristic, because we shall have occasion to recur to it; it will serve us to establish the fact that up to now the facts prove that, by hybrid fecundations, one will obtain, in whatever part of the plant they present themselves, the variations of color only, limited to those of the parents" (p. 18).

Since Verlot's view regarding the nature of a hybrid was the conventional one that it consists of a cross between what are commonly called distinct species, he was led to notice the very common fact of comparative sterility in these cases. Noting the well-known characteristic of augmented vegetative growth in hybrids, he is led to ascribe the seed sterility to the latter, a conclusion easily if naïvely arrived at from the well-known inverse relation between undue vegetative luxuriance and seed reproduction. As an instance of intermediacy, Verlot alludes to the matter of height: "In crossing an almost dwarf species with the pollen of a taller species . . . the seeds of this cross will undubitably produce individuals taller than was their mother" (p. 44).

Regarding intermediateness in size in flowers, he says: "In crossing a species *parviflora* by its variety *grandiflora* we shall be able . . . to obtain individuals with flowers larger than those of their mother . . . by crossing one is able then to create a race or a variety in which the size of the flowers will be augmented" (p. 47). With regard to the same matter in respect to earliness and lateness, he says: "Supposing one crosses a very early plant with its very late variety, or *vice versa*, one will only be able to obtain varieties intermediate between the parents in earliness or lateness" (p. 50).

Regarding fragrance he mentions the case of a cross between *Rhododendron ciliatum* (odorless) and *R. Edgeworthii* (very fragrant), the hybrid being less intensely fragrant than the pollen parent (p. 31). In the matter of color intermediateness he makes the statement: "Once obtained, white coloration is able to serve, either by crossing or by hybridization, in the production of new variations, ordinarily intermediate

between it and the color from which it has proceeded" (p. 59); in other words, as we should say today, dilution through the presence of but a single dose of the color factor.

The most interesting portion of Verlot's memoir is his discussion of the practical results achieved with ornamental plants in the field of hybridization. Regarding dwarfing he cites McNab (p. 42), to the effect that the best dwarf varieties of rhododendron are obtained by the use of pollen taken from the small stamens, "the products of which," he says, "I am able to certify, are very different from those obtained by the use of the pollen of the large stamens." Regarding breeding for winter hardiness, he mentions the case of the cross of *Amaryllis brasiliensis*, a delicate species impossible to winter out of doors, by *Amaryllis vittata*, a much hardier plant, whereby hybrids were produced which, with light covering, would support the climate of Paris. Likewise *Rhododendron arboreum*, which cannot resist more than 2 to 3 degrees of cold, gave, when crossed by *R. catawbiense* (a much hardier form, though with inferior inflorescence), hybrids which inherited the hardiness of the female plant.

Verlot did not recognize the phenomenon of dominance in the first generation of the hybrids, but he mentions the case of a white *Gloxinia* crossed by pollen from a blue-flowered variety, in which out of one thousand seedlings "all bore nothing but perfectly blue flowers, not a single one of them being white, nor a single one variegated" (p. 65). Likewise the crossing of the same plant by a red-flowered variety gave the same result, "all the plants coming from sowings of seeds thus produced had entirely blue flowers" (p. 65).

Regarding the inheritance of variegations it may be of simple interest to note that the following species are mentioned in which the variegated form breeds true from the seed. *Alyssum maritimum*, *Barbarea vulgaris*, *Celtis australis*, *Cheiranthus cheiri*. With these are to be included the variegated ferns *Pteris argyraea* and *P. aspericaulis* var. tricolor.

He remarks upon an interesting fact that the variegations do not appear upon the first leaves of a variegated variety. Regarding the heredity of double flowers, he reports no crosses, but simply remarks upon cases of double-flowered peach and apple which came true from the seed (p. 83).

Another interesting piece of information given is that, in the case of double camellias, the full round seeds produced plants with very double flowers, while the more elongated seeds produced plants with single or but slightly doubled flowers (p. 87). Among color variations in plants, few are more interesting than the red or copper-leaved forms of ordinary green-leaved types. It may be of interest here to note Verlot's citations of such color varieties as are homozygous for the color, and which hence come true to type, among the recorded instances being the purple beech and the purple-leaved barberry.

One of the most interesting matters recorded in Verlot's paper, is his citation of Bridgmann's investigations on the inheritance of leaf variation in ferns. Many species of ferns show various degrees of leaf laciniation, the latter becoming often many times compounded. In the case of several species of *Scolopendrium* with crisped or laciniate leaves, spores were separately sown from the modified and from the unmodified leaves, with the result that the resulting plants, although derived from the same original plant as a parent, inherited the characteristics of the particular leaves or parts of leaves from which the spores were taken.

"The spores from the deformed part of the frond were collected and sown separately. . . . The result was that all the plants which came from them reproduced the crisped form of the individual mother plant, and some of them even in a higher degree" (p. 98).

"The spores from the normal part of the frond, which had furnished the first sowing, were collected with the same care, and sown under identical conditions. There originated in the same way thousands of young plants, but it was scarcely possible in the

quantity of them for one to find a dozen which showed, even to a feeble degree, the irregularities of form so characteristic of the first lot. The two sowings were so different from one another that, if one had not known their derivation, one would never have been able to believe that they were such near relatives. The great majority here were perfectly normal; as to the small number of those which showed traces of the maternal monstrosity, this monstrosity was limited to fronds bi-lobed or tri-lobed at the top, with the edges more or less sinuous or a little slashed; yet this alteration most often did not reach more than one or two fronds on the same individual" (p. 98).

VERLOT'S SUMMARY

Verlot summarizes his views upon hybrids in the following words, which are worth reproducing because they fairly well represent the general knowledge of the time, as follows: (1) "Hybrid fecundation is not able to produce anything but variations which will be able, it is true, to multiply themselves mechanically, but which will not be fixable, and which consequently cannot be brought to constitute races or varieties, the products which arise from them being sterile, or if they are fertile, having only a fertility limited to a few generations, or disappearing after a certain time by the disjunction of the types. (2) One of the characters of the hybrids is also a great development of the vegetative organs, coincident with less abundant flowering. They are in general intermediate between the species types, but often approach more the father. (3) The hybrid, self-fertilized, returns more or less rapidly to the parents. (4) The hybrid, fertilized by a parent, returns also promptly to the parent. (5) Crossing—that is to say, reciprocal fertilization of varieties or races of the same species—will serve for obtaining new variations, intermediate between the parents, very fertile, and which can be fixed more or less rapidly, and constitute new varieties or races."

Reviewing this list of statements in the light of present knowledge, we can see that they constitute a more or less correct, non-scientific formulation of the truth. For example, the more or less rapid return of hybrids—that is to say, heterozygotes—to the parental forms, is well established today as a fact of segregation according to Mendelian ratios, which, if there is a single pair of allelomorphs in question, goes on, on a 1.2.1 basis in each successive generation. The more or less rapid return to its parents of the hybrid fertilized by a parent is simply the splitting off of 50 per cent dominants or recessives as the case may be, and which are the parental types in the case of simple ratios.

WICHURA'S WORK

In 1865 there appeared Wichura's memoir on the hybridization of plants (10), based upon experiments in the crossing of willows, which had occupied him from 1852 to 1858 inclusive. A brief preliminary report had appeared in *Flora* in 1854, and also within the same year in the report of the *Schlesische Gesellschaft*.

Taken as a whole, Wichura's work dealt, not with the investigations of individual specific characters but with species taken entire and crossed as such. As was the general custom, he regarded a "species" as an integral whole that could be crossed in its entirety. With this conception he made what he called "binary," "ternary" and "quaternary" crosses, *i. e.*, crosses: (1) between two species; (2) between a species and a hybrid; and (3) crosses between two hybrids. Besides the smaller list of Wichura's successful crosses, he published a much longer one of his failures, which stand as evidence both of the considerable amount of crossing work that was done and of the scientific integrity of the experimenter. Of the ordinary, or, as he calls them, "binary" crosses, Wichura made, in all, thirty-five successful crosses and combinations of crosses (of which ten were "binary," *i. e.*, simply crosses in the ordinary sense) between twenty-one different species of willows.

Although, as has been stated,

Wichura, no more than most of the other hybridists of his day, paid attention to the crossing of characters as such, he remarks upon the evidence of individual characters being inherited as such: "It was of interest," he says (p. 27), "to observe how the unusual narrowness of the leaves in the experiment, utilizing *Salix purpurea* × *viminalis*, remained still recognizable in the following generation; a proof that, even in hybrid fertilization, individual characteristics of the parent plants can be inherited." (Italics inserted.)

Wichura noted in willows, as others had done in other plants, the fact of a higher degree of sterility on the part of hybrids obtained between species of more distant specific relationship. The greater amount of vegetative vigor of hybrids was remarked upon by Wichura in the following words (p. 40): "Not only in the reproductive organs, but also in their vegetative behavior, hybrids show many phenomena whereby they are more or less strikingly distinguished from true species. According to the corroborating observations of Koelreuter and Gärtner, a larger part of the hybrids obtained by them by hand crossing, were distinguished by luxuriance of growth. The plants grew to a greater height than the parents, spread out farther laterally by virtue of an increased capacity for sprouting, had a longer life-period, were able to withstand cold longer, and had more abundant, larger and earlier flowers than the parents. . . . Among the willow hybrids, similar phenomena occur, but the examples of luxuriant growth by no means constitute the rule."

Wichura further observed that: "Even the most sterile hybrids fall behind the parents in their productiveness. A certain deficiency in the parts set aside for reproduction must therefore also occur with them, and if we associate this in reverse relation with the excess of their vegetative development, it stands in complete harmony with the facts otherwise demonstrated. We shall therefore have to say, in order to express the relationship correctly, that in the case of very vigorous hybrids the weakness of the sexual parts brings out an increased development of the vegetative growth, whereas it is not the case with others which are too weak for such a reaction" (meaning crosses between too distant species) (p. 43).

Wichura concluded from his observations that hybrids were intermediate in respect to the differing parental characters. Cases of dominance do not seem to have come under his hand. "Among the numerous artificial and natural willow hybrids observed by me," he says, "I have throughout verified but one apparent exception to the principle of intermediateness. . . . Even the time of flowering of hybrids holds the mean between the time of flowering of the two parents" (p. 47). "The leaf-form of *Salix caprea* × *viminalis*, for example, holds so completely the mean between the linear-lanceolate leaves of *S. viminalis* and the round-ovate leaves of *S. caprea*, that they in fact appear to represent the mathematical mean between the curves for the outlines of paternal and the maternal leaves" (p. 47). With regard to what we should call absence of dominance, he has to say (p. 50): "As rich in species as the genus of the willows is, and as numerous combinations of hybrid fertilizations as it has to show, nevertheless I have never yet verified anything of a preponderant influence in any one of its species, but rather always found that their hybrids always hold the mean between the constant characters of the parents"; and again (p. 86): "In hybrid fertilization, if unlike factors unite, there arises an intermediate formation, etc."

The latter passage appears to be the first occasion where the term "factor" has been used in the literature of plant breeding, although here the factors referred to are the parents as a whole which participate in the cross, and not the character-forming elements of those parents. His general conclusion is (p. 46): "Constant characters, through which the parent species are distinguished from one another . . . go half over to the hybrid, so that it holds the middle position between them."

Two observations of Gärtner's were verified by Wichura—the identity of reciprocal crosses (pp. 51 and 186), and the fact of "variation" in hybrid progeny.

The question was as to the relative importance of the egg or the pollen in the result of fertilization. Wichura says (p. 57): "One sees the question is still far removed from having been brought to light, but from Gärtner's and my own observations it appears at least determined that the products of hybrid pollen in breeding are more various than those of the pollen of true species."

From the generally admitted identity of reciprocal crosses, Wichura draws the following conclusion (p. 86): "We have found that the products which come from reciprocal crossing, unlike the well-known experiments made in the animal kingdom, completely coincide with each other. *From this it follows, however, with mathematical necessity, that the pollen cell must have exactly the same share in the conformation of the fertilization product as the egg.*" (Italics inserted.)

So far as the writer knows, this is the first complete categorical statement in the literature of breeding of such a conclusion as to the behavior of the sex cells in amphimixis. One is completely impressed, in reading Wichura's work, with the scrupulous care, accuracy and precision with which his hybridization experiments were carried out. One or two passages in point are interesting. Referring to a case of Gärtner's, where exceptional types appeared in the midst of "a greater number of hybrid plants of completely similar hybrid types," he says (p. 53): "To judge concerning the here-mentioned exceptional types without myself having seen them is scarcely possible. From the relatively limited number of my experiments, which have not yielded the like, I cannot, to be sure, deny its possibility, but here likewise, as above in the case of reversions, the suspicion of a complete disturbance of the experiment, whether that the protection had not been complete, or the pollen utilized for fertilization not pure, or the seeds sown not free from foreign admixture. Whoever knows from his own experience how much care must be observed in order to keep an experiment clean becomes skeptical respecting all results of an experiment which vary from the usual rule, of the correctness of which one has not achieved conviction through his own observation."

Regarding these and other so-called anomalies as the result of crossing, he again says (p. 89): "That concerning all these points and many other disputable questions . . . we know so little, has indeed its basis in part in the method hitherto of artificial cross-fertilization, which suffers from the double deficiency that the care requisite to the correctness of the experiment, through the exclusion of foreign pollen, has not been taken in the first place, and second, that although many experiments have been instituted in very different families, nevertheless the individual hybrids have not been bred and observed in sufficient number. However, this is imperative throughout for attainment of general results. Only when one has at hand the same hybrid in hundreds of cases, partly from the same, partly from different parents, repeated through different years, only then will one be in position to separate the essential phenomena of hybridization from the more accidental ones."

Finally (p. 92), Wichura remarks, expressing the hope that a learned society or an individual with means might repeat his own experiments on a larger scale: "The most scrupulous exactness in such case would be indispensable. Failing this, and especially if the possibility of the access of foreign pollen is not completely excluded, then all experiments, the more extensively they are undertaken, only contribute so much the more to the confusion of the matter. This must be taken to heart."

Regarding the possibility of securing, in any given case, a cross, Wichura remarks (p. 84): ". . . only such species can be united in a hybrid which agree in relatively many characters, and correspondingly in many life conditions. Experience teaches the same thing in the familiar rule, that hybrid combinations

only occur between species of the same genus, or though different, yet nearly related genera." This statement represents a point of view resembling that held by Gärtner, as we have seen. He comes to a generalization of genetic value in the following statement (p. 85): "It is known that families die out, after a few generations, whose members carry in themselves the germ of a disease, and who marry only among themselves; and variety breeders know very well that all diverging characters of animal and plant species may be intensified, when, in successive fertilization, the precaution is taken that only similarly divergent individuals mate with one another."

This closes the account of the work in the field of hybridization from the time of Koelreuter to the time of Gregor Mendel, 1760 to 1866. Mendel's investigations, however, did not become generally known until 1900, so that very little change occurred in the methods pursued in the study of hybrid phenomena until after the date last mentioned. Comparatively few students of plant breeding, however, realize the historical value of the work of the earlier hybridists, in whose experiments lie the germs of our present knowledge.

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A COMMERCIALLY NEW BLUEBERRY

George E. Murrell

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M. A. SAPP lives 3½ miles from Crestview, in northwestern Florida, about half-way between Pensacola and River Junction. Some twenty years ago he conceived the idea of testing as a horticultural crop the wild plant known locally as the high-bush swamp-huckleberry. While Mr. Sapp has no technical horticultural training or experience in methods of plant breeding, he is one of those men who combines keen powers of observation with feeling for plants and ability to apply himself closely to a study of their requirements. Locally he is known as a particularly successful farmer.

Mr. Sapp visited a swamp not far from his place during the ripening season and tagged the blueberry bushes which appeared to him the most desirable from the standpoint of productiveness and size of fruit. In the succeeding autumn he transplanted one hundred of the bushes he had tagged to a well-drained field near his home, settting them out in rows spaced so that they would be 14 by 15 feet. This made about 200 bushes to the acre. He found that the suckers grew readily and that in their new environment they made better growth and fruited more profusely than they did in their native swamp. When he began to market the berries he encountered such an excellent demand, and was able to obtain such good prices, that he decided to extend his planting. He now has his original half acre, which is twenty years old; an acre which is twelve years old; 3 acres which are five years old; and 2 acres two years old, making a total of 8½ acres.

The plants commence bearing the second year after being set in the field, and at five years of age yield commercial crops of fruit. From the age of eight onwards they average half a bushel of fruit per plant annually, making the yield 3,200 quarts from an acre.

At the present time there is little apparent difference in productiveness between the twelve-year-old bushes and those twenty years old. There are, however, distinct types of plants occurring in the plantation. One type is stocky, compact, freely branching in habit, reaching about 8 feet in height and spread, with the fruit well distributed throughout the plant. The leaves of this type are ¾ inch by 1½ inch in size, lead-blue in color, with a distinct bloom upon the upper surface. The second type is erect in habit, many stemmed, 10 to 12 feet in height, with the fruit borne mainly on the ends of the branches. The leaves of this type are 1 inch by 2 inches in size, pale green in color. In addition to these two principal types there are several intermediate ones, varying in season of ripening and size of berry.

The botanical standing of this blueberry is somewhat in doubt. The description of *Vaccinium virgatum* Ait. appears to cover this species, yet there are certain differences which may, when the plant is studied more carefully, lead to its being classified differently.

Variation in productiveness is marked. In 1918, one bush yielded 20 quarts at a single picking, 3 bushels during the season. Others do not yield so abundantly. Mr. Sapp has found that the compact bushes are, in general, as productive as the tall ones, and the fruit is more easily gathered, hence he is confining his plantings at present to this type.

The season extends from May 20 to August 20, the bulk of the crop ripening in June and July. Pickings are made weekly throughout this period. The

A BLUEBERRY BUSH OF THE ERECT TYPE

Blueberry bushes vary in habit of growth. The one here shown is of the erect type; others are compact, spreading, and even drooping in form. This is considered by M. A. Sapp to be the most desirable type. A bush like this may yield 20 quarts of fruit in a single season. (Fig. 5.)

berries remain in good condition for several days and can be shipped without difficulty. They are sold on the farm at 10 to 12½ cents per quart. Up to the present Mr. Sapp has not attempted to ship to distant markets, as the local demand has exceeded the supply.

In diameter the berries vary from 10 to 14 mm. They contain seeds like those of other vacciniums, and in about the same quantity as the average blueberry of the north. The color is blue to black, the flavor sweet, pleasant, so agreeable that the fruit is satisfactory for eating out of hand as well as cooked. The unusually large size which is characteristic of Mr. Sapp's blueberries makes them of great interest.

The land upon which they are being grown is typical of thousands of acres of pine land found in the South Atlantic and Gulf states. The surface is sandy loam, the subsoil a sandy clay, with the water table 10 to 15 feet below the surface.

Stimulated by the success of the Sapp plantation, several other plantings have been made by people in the same section of Florida. D. T. Finlason, at Laurel Hill, some distance north of Crestview, is making a serious study of the matter, and has brought together on his place an extensive collection of varieties. In transplanting suckers from the swamps into the home garden, it has been found that they should be

ONE OF THE FIRST BLUEBERRY PLANTATIONS IN THE SOUTH

Part of the eight and a half acre plantation of M. A. Sapp in northern Florida. The bushes were transplanted from a neighboring swamp, and their culture has proved commercially profitable. Mr. Sapp has been able to improve the character of his fruit and increase productiveness by selecting the most desirable plants and propagating from them. (Fig. 6.)

A FRUITING BRANCH OF THE SOUTHERN BLUEBERRY

An acre of plants yields 3,200 quarts of these berries, and M. A. Sapp has found no difficulty in marketing them at 10 to 12½ cents a quart. The productiveness of the plants is indicated by this fruiting branch, here shown considerably reduced in size. (Fig. 7.)

set somewhat more deeply than they originally grew.

It is evident that the commercial possibilities of this fruit are excellent. All who are growing it state that the supply far exceeds the demand. Its culture is simple, it produces its fruit in the greatest abundance, and the prices obtained have been very satisfactory.

A Common Misconception Concerning Human Heredity

"Important as the heredity which has stamped its hall-mark upon an organism or an individual may be, there is another factor constantly at work in molding it, namely, its environment. The finished article, be it vegetable-marrow or man, is the resultant in a parallelogram of forces, the factors of which are heredity, or what it brings with it into the world, and environment, or the play of world forces upon it. So far as it concerns the individual, heredity stops at his birth, though the burden or the treasure it may have bound upon his shoulders is sometimes not revealed till after a long period of years. Its greatest influence is antenatal. The environment of the parents may affect the heredity of the child for good or ill, but the major part of the effect of environment is a post-natal and personal matter.

"A leek or a lily grown in the open air has green leaves, but if the plant is forced to live in a dark cellar where the sunlight cannot reach it, its leaves are white. It requires the energetic touch of the sun to enable it to elaborate the green chlorophyll, which gives it its verdure. Or it may be grown in the sunlight, in soil from which all traces of iron have been removed, and its leaves will remain pale. But if a little iron be added to the soil the leaves will quickly assume their natural hue. Here we are dealing with only one factor in the environment; but in nature, as a rule, the circumstances are more complex.

"The response to the conditions of environment are well shown by the behavior of certain Alpine plants. If taken from their natural habitat and cultivated in the lowlands, they undergo material alterations in character. They grow to a greater height and their leaves expand in length and breadth. So long as the plant remains in the lowlands it will exhibit in each successive generation these altered characters. But if one of the plants is transferred once more to its original habitat, high up upon the bleak mountains, it will once more assume the Alpine characteristics, which continue to persist so long as the plant or its descendants live under the same conditions. . . . In the nature of things it is perhaps to be expected that the influence of environment should make itself felt in plant life; but it plays a great part in producing modifications of animal life as well."

The above quotation from "The Adventure of Life," by Dr. Robert W. MacKenna, represents a mistaken assumption in regard to heredity that is very frequently encountered even in text-books on eugenics. It is an established generalization that the rôle played by environment in producing wide modifications compatible with life is far greater in plant life than in animal, and far greater on the simpler animal tissues than on the more complex.[1]

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[1] See Popenoe and Johnson, "Applied Eugenics," p. 3. New York, 1918.

THE DRAMATIC CAREERS OF TWO PLANTSMEN

David Fairchild

PLANTSMEN are born, and are seldom or never made by education. A man may be a good botanist and not be a good plantsman, for a botanist's interests lie in the names of the plants or their morphology or anatomy or cytology or in their chemical constitution. He may be an expert botanist and yet in the country, surrounded by trees and fields of wild plants, be unable to tell one species from another. A plantsman, on the other hand, loves plants for their own sake and, as he wanders through life, forms the habit of knowing the trees and shrubs and weeds growing about him and is not satisfied if he cannot identify at least the families to which they belong. This love goes deeper still if he is a true plantsman. It makes him unhappy if he is not growing plants himself and watching them develop.

The careers of two of the world's true plantsmen have just closed, and in such dramatic fashion that the cable despatches regarding their deaths have been published throughout America: Frank N. Meyer, of Amsterdam, Holland, and Aaron Aaronsohn, of Haifa, Palestine—the one while descending the Yangtze River, the other in a fall in an aeroplane off the north coast of France.

By that strange attraction which brings congenial people together, Frank N. Meyer, for years the assistant to Hugo de Vries in Amsterdam, drifted into the organization of the Office of Foreign Seed and Plant Introduction, became an American citizen and an agricultural explorer, and Aaron Aaronsohn, Director of the first American agricultural experiment station on the shores of the Mediterranean, became a foreign collaborator of the same office.

Through these coincidences I came to know intimately these two remarkable men, whose work in the discovery of new plants for the use of plant breeders has already become history.

For nine years Frank Meyer wandered on foot along the narrow pathways of China, gathering the plants which he believed would grow in America. As I write of him here, his hardy yellow rose, *Rosa xanthina*, peers in upon me through my study window, and up in the border his scarlet lily is in bud, while the perfume of his lilac has barely passed away. His white-barked pine is dusting its pollen into the air, his Euonymous and his hardy bamboo are growing at the corners of the house, and his dry-land elm with its delicate branches shades the entrance. So much of China has he successfully transplanted to this country.

Meyer's memory of the forms of plants as they appeared in the open was remarkable. In this lay his great power. He could keep in his mind the characters of thousands of plants—many of which he had only once seen—and this enabled him to recognize at once any which were strangers to his experience. It is this form memory, inborn certainly, but trained by years of solitude in forests and by long tramps through the fields looking for flowers, that proves such an invaluable asset in the profession of an agricultural explorer. This, combined with the enthusiasm of a boy to whom everything is new, made Meyer unique as a hunter of plants.

The plant breeders of America and of all countries where the problems are similar will benefit by Meyer's explorations in many ways, for he had the tastes of a plant breeder and expected, when his traveling was done, to settle down in a plant-breeding garden somewhere in the Rocky Mountain region, where a high altitude and cool weather would enable him to carry on breeding work

PIONEER AGRICULTURAL WORK IN THE ORIENT

The first agricultural experiment station to be developed along American lines in the Orient was started at Haifa, Palestine, by Aaron Aaronsohn. Its progress, which was being watched with interest by plantsmen throughout the world, was interrupted by the world war, but Dr. Aaronsohn, who is here seen examining one of his irrigation ditches in company with his secretary and his foreman, intended to resume experimental work the moment peace was restored. Just at the moment when it seemed possible to do this, and he was making plans to that end, he met his death in the fall of an airplane.

FRANK N. MEYER. AGRICULTURAL EXPLORER

The plant explorer's reward comes from seeing the fruits and flowers which he has gathered in remote corners of the earth growing successfully in his own country. Fortunately, Frank N. Meyer lived to see many of his own introductions established in the United States. The one which he is here examining in the Plant Introduction Station at Chico, California, is a walnut which he sent from northern China.

throughout the summer. His notes, published in the "Inventories of Seeds and Plants Imported," of the Office of Foreign Seed and Plant Introduction, are full of suggestions to plant breeders, and, luckily, his suggestions are backed up by living material which will make it easy to provide the breeders with many of the plants which he describes.

Meyer collected a very wide range of plants. He collected wild alfalfas in the Caucasus, Chinese Turkestan and Siberia; sorghums and Chinese pears in Manchuria; wild peaches and almonds in the Kansu Province; chestnuts east of Pekin; persimmons in the Ming Tombs Valley; wild conifers in the Wu Tai Shan; citrus fruits on the Upper Yangtze; bamboos and strawberry trees (the Yang mae) south of Shanghai; jujubes and the pound peach in the Shantung Province; dwarf almonds, dwarf cherries and apricots and large fruited oleasters in Russian Turkestan; desert poplars and tamarisks, wheats and barleys in the desert region of Chinese Turkestan; wild apples and apricots in the Tisu Shan range which divides Siberia and Chinese Turkestan; large fruited black currants from the Yakutsk Province of Siberia.

I doubt if any man has traveled more miles on foot than Meyer did, in search of his plants. He was attacked by ruffians in Harbin; his life was threatened by Chinese soldiers in Kansu, who stood him up against the wall. He spent months in the uncomfortable inns and was quartered in temples and other strange places in China. He ran the gauntlet of suspicious Russian officials on the border between Siberia and China at a time when the relations between these two countries were strained. He had the distinction of having his photographs of deforestation in China used by President Roosevelt in his message to Congress. Shut in by the Chinese revolution in Ichang for many months, his health, which had begun to feel the effects of lonely travel, broke down and, when finally he succeeded in escaping, the strain appears to have been too much. He disappeared from the river steamer in the middle of the night of June 2, 1918, and his body was found several days later by the American consul at the little town of Wuhu, where the Chinese, who had found it in the river, had temporarily buried it, and from which place it was taken to Shanghai, where it now rests.

Aaron Aaronsohn began his life on horseback, so to speak. On his Arab steed he traversed the Jordan and climbed the slopes of Mount Hermon in the Holy Land. Educated as a protégé of Baron Rothschild, in Grignon, France, and as a friend of the African explorer Schweinfurth in Berlin, he early became interested in the wild plants of Palestine and made collections of the wild forms. Urged on by his professors in Bonn and Munich to discover the origin of the cultivated wheat plant, he found on the slopes of Mount Hermon a truly wild wheat, which has been subsequently named by O. F. Cook in honor of the discovery, *Triticum hermoni*. Because of the fact that certain crosses of cultivated wheats revert to it in character, and from the fact of its undoubted wild character, it appears in all probability to be one of the progenitors of wheat, the greatest cereal of civilized man, rather than a cultivated form gone wild.

Coming to America to study American conditions, Aaronsohn interested the Department of Agriculture in his Palestine researches, and through the friends he made here and guided by the advice of department men, he established the first agricultural experiment station along American lines to be started outside the confines of the United States.

After four years of organization work, the war storm broke over the institution, wrecked it completely and forced Aaronsohn to flee. His life, which had been spectacular enough during peace times, became infinitely more exciting, and the story of his escape through Austria and Germany into Denmark on the plea that if he could only get the advice of Johannson of Copenhagen or Nilsson of Svalöf, Sweden, he could produce by a selection a variety of sesame which would produce increased

amounts of this oil-producing seed and relieve the oil shortage, seemed as he told it to me like a chapter out of the Arabian Nights. He told me how he, by cablegrams to America, got the English Consulate to give him papers to England, and how he threw these away in order that he might be arrested as a spy on arrival at Folkstone and so conceal from the Turks the fact that he had deserted and thus save his own family from massacre, only to hear later of their murder; how he showed General Allenby the water-bearing strata where artesian wells should be sunk in Palestine and aided him in placing his artillery so as to produce the greatest effect on the cliffs and fortifications he was attacking; how he saw Balfour and was of influence in getting him to make his promise of "Palestine as a home land for the Jews"; of his work in Bulgaria to pull her out of the war—all these war activities of Aaronsohn's will doubtless find their place in the histories now being written of the Great Struggle.

That, just as the war clouds are lifting and he was making plans to put in new crop plants and start a new agriculture on a quarter of a million acres of land in Palestine, and was hurrying through the air from London to Paris, he and his pilot should instantly drop through the fog into the sea and be lost, seems too hard to believe, for we had come to feel that there on the eastern, Oriental end of the Mediterranean there was coming into existence a type of experimental agriculture which would be epoch-making and that Aaronsohn was the man destined to bring this about. When the war broke, a beginning in plant exchange had been made, and the plant breeders of America will find in Aaronsohn's bulletin on his agricultural explorations in Palestine a large number of valuable suggestions regarding the possibilities of new dry-land cereals, stocks for the jujubes, oil-producing grains, the carob fodder tree, and cover crops for citrus orchards. The date growers in the Salt River Valley have grown some of the date palms which Aaronsohn got for them in Egypt, and the desert hawthorn which he sent in is being tested as a stock for early pears.

The plans of these two remarkable men, the myriads of observations made, the knowledge gained from their reflections in solitude—all are lost to the world at a time when it can ill afford to lose such things and just as their discoveries were beginning to need their guidance.

May their lives encourage, somewhere in the world, young men starting out to live, to find their careers in the field of plant breeding and plant exploration.

Corrections in an Article on Poultry Breeding

Typographical errors unfortunately appeared in the article by Professor Lippincott, "The Breed in Poultry and Pure Breeding," which appeared in the February number, 1919. These are of a technical nature and require correction in order to make the article intelligible. Page 77, eleven lines from the bottom, P=white (no pigment) should read p=white (no pigment). Same page, two lines from bottom; b=indicates, etc., should read *b*=indicates, etc. Page 78, twelve lines from the bottom, for pp (Re)(rE) Bb read pp (Re) (rE) B*b*. Five lines from the bottom, right-hand column, the same correction should be made. The four lines at the bottom should read:

Offspring (1) Pp (Re)(Re) bB = Barred splashed ♂ ♂
(2) Pp (Re)(rE) bB = Barred blue ♂ ♂
(3) Pp (Re)(Re) b*b* = Non-barred splashed ♀ ♀
(4) Pp (Re)(rE) b*b* = Non-barred blue ♀ ♀
} Equal numbers

AN IMPROVED STRAIN OF WISCONSIN TOBACCO

Connecticut Havana No. 38

James Johnson

Wisconsin Experiment Station[1]

THE instances of improved types of tobacco, which are accepted as such commercially, together with data covering a number of years to show where such improvement lies, are sufficiently rare to warrant recording. In 1908 a project for the production of an improved strain of Wisconsin cigar binder tobacco was undertaken, together with a study of certain principles of inheritance involved in crosses and in simple selection with tobacco. Some of the results secured on the latter problem are to be published elsewhere. It is desired here to record only certain aspects of the production of a commercial strain of tobacco.

During the summer of 1908, about 2 acres of Connecticut Havana tobacco were grown at the Experiment Station Farm at Madison, largely for seed purposes, with the idea of introducing this variety widely throughout the tobacco-growing regions of the State. Several hundred pounds of this seed were distributed annually for a period of three years and it met with considerable success. A great many growers, however, reported that although the quality was very satisfactory the yield of this type should be increased. The exact history of the strain of Connecticut Havana which was grown is not definitely known, although at the time of its introduction here it was not far removed from some of the best strains grown under this name in the Connecticut Valley. Repeated comparisons with the widely grown variety of Comstock Spanish of Wisconsin, the Connecticut Havana, and the Zimmer Spanish of Ohio, showed that they were all practically identical and could be all classed in one group as "Havana Seed."

The Connecticut Havana grown for seed in 1908 was presumably "pure-bred" seed. A great deal of attention was paid to roguing out seed plants and selecting and bagging plants for further study during this year. Seed from about thirty-five plants was self-fertilized and the majority of these sowed separately and transplanted into progeny rows in 1909. It became evident from this test that three fairly distinct types of tobacco were present in the progeny plat, but that the progeny from each parent plant was remarkably uniform. The majority of the rows were practically identical and typical Connecticut Havana tobacco, but two rows, viz., Selection No. 26 and Selection No. 27, stood out distinctly from the others. Type 26 differed from the normal type in that the leaves were smaller in number but considerably larger in size, and also were more pendant than those of 27. Further, the stalk was shorter, thicker, and tended to lodge more than the normal type under unfavorable weather conditions. Type 26 also budded slightly earlier and matured earlier than the normal. Type 27, on the other hand, differed from the normal in that it possessed a greater number of leaves, which, on the whole, were somewhat smaller in size than the normal. The leaves were very erect in position. The stalk was a little more slender, somewhat taller than normal, but very strong, and rarely lodged. This strain

[1] Published by permission of the Director.

ONE OF THE PARENTS OF CONNECTICUT HAVANA NO. 38

This tobacco plant represents Strain No. 26, isolated from the Connecticut Havana variety. It is the female parent of Strain No. 38, of which 10,000 acres are now grown commercially in Wisconsin. (Fig. 8.)

budded and matured on an average of a week or ten days later than the normal.

It is assumed that strains 26 and 27 are "mutations" from the normal. The reasons for this assumption lie primarily in the fact that both types differ from any other variety or strain which has previously or since been grown at the station, and hence their occurrence in the Connecticut Havana variety was presumably not due to an intermixture of seed. On the other hand, these strains have now been grown for ten years and during this time have shown no sign of segregation but have remained remarkably uniform as to type.

Both strains 26 and 27 possessed some commercial advantages over the normal, as, for instance, the size of the leaf in 26 and the number of leaves in 27. On the other hand, both possessed points of lesser value than the normal, as, for instance, the reduced number of leaves in 26 and the reduced size of leaves in 27. The quality of the leaf in both seemed to be in no way inferior to that of the normal, although the time of maturity of 27 might, under certain conditions, prove undesirable.

It at once became evident that, if the desirable qualities of the two strains could be combined into one plant, a considerable improvement over the normal might be expected. Accordingly this cross was made along with a large number of other crosses of varieties and strains made during 1909 for the same purpose. The first generation of the cross 26♀ × 27♂ was given in 1910. The cross showed to a very large extent a very desirable intermediate condition of the characters of the two parents, and, in an unexpected manner, produced a plant whose conformation very closely approached the ideal in mind. This type was given the number 38 as a means of readily distinguishing it from the numerous other types grown. The second generation of the cross was grown in small numbers in 1911, but in 1912 and succeeding generations was grown in large numbers, although data were unfortunately not taken upon large numbers in the second generation. Field observations upon a large number of individuals, however, have convinced the writer that there was no marked segregation into types such as occurred when certain varieties of tobacco were crossed and grown under similar conditions. Whether the segregation was of such character that it could not be detected or did not occur at all may be regarded as an open question. The writer is inclined to believe, however, as a result of data and observations on this and other crosses in tobacco, that under certain conditions, where the strains crossed are closely related, "blended" inheritance only may occur, segregation into parent types and intermediates being absent in the second filial generation. Whether this assumption, which has been noted in several variety crosses of tobacco (together with segregation in others) be true or not, it is evident that differences in habit and form of growth and in quality which cannot be detected by careful observation can have no significance from a commercial standpoint, although segregation in characters concerned in quality may occur. No evidence of such segregation has been found, but it is exceedingly important that no segregating strain, no matter how small the variability may be, should be introduced into cultivation. In order to be further certain of this, therefore, the new strain was grown for four years at the station before being distributed to growers and then the distribution was limited to small amounts for experimental purposes. Following fairly extensive distribution in 1916, however, the writer was convinced that the quality was sufficiently uniform to warrant the general recommendation of this seed to Wisconsin growers. The strain has met with considerable favor among the growers from the standpoint of appearance and yield in the field and from the standpoint of the cured product on the part of the buyers. The strain owes its value, not to its being widely different from the best varieties grown in the State, but rather to its general similarity to these varieties combined with the fact that it is a

distinct improvement over them in some respects. Such improvement apparently could not be obtained from the standard variety by simple selection alone, as has been shown by such trials carried on simultaneously.

The chief advantages claimed for Connecticut Havana No. 38 are due to the desirable habit of growth it presents in the field, the leaves being quite erect in position, rendering the necessary field operations more easily accomplished. The leaves are quite uniform in size from top to bottom of the plant and are somewhat broader in proportion to their length than those of the ordinary Havana seed. It possesses on the average one or two more leaves to the plant than does the ordinary Havana, while, at the same time, it has a greater average size of leaf. The quality is not inferior to that of Connecticut Havana seed, at least under Wisconsin conditions. Although no carefully controlled experiment on the relative yield of Connecticut Havana No. 38 and of ordinary Havana seed has been made, it appears from the data secured on leaf number and size that on the average it will yield 7 to 10% more than the ordinary Havana seed.

The data upon which most of these conclusions are based are presented in Table I, covering a period of nine seasons. During each year measurements and counts were made on about twenty-five plants of each type and the averages only are given for the four types 26, 27, 38, and 33, the latter being a product of a continued selection and imbreeding experiment with the ordinary Connecticut Havana type. During two or three years all the data could not be secured, either because of insect injury or, as in 1916, when the data were discarded as unreliable because of the effect of Mosaic disease upon the plants. In other years the root-rot disease due to Thielavia was a factor in reducing size, but it was considered that the influence had the same relative effect on each, since in these types there was no evidence of variation in resistance to the disease. It should be said here that Connecticut Havana No. 38 is no more resistant to the Thielavia root-rot disease than the ordinary Spanish or Havana types of seed, and the grower is likely to be disappointed in low yields obtained on infested soils. This strain preferably should not be grown on Thielavia infested soils. Where the grower expects to plant tobacco on root-rot infested soils or on old tobacco fields, he should obtain a resistant type of seed. Such types are now being developed at the Wisconsin Station in coöperation with the United States Department of Agriculture and may in the future largely displace the susceptible strains of Havana tobacco, provided an equally high quality can be produced in the resistant types.

Referring to Table I, it will be noted that numbers have been gradually added to the designation. Each digit following the original number indicates an added generation of inbreeding so that the number of generations a seed-plant has been inbred can be readily determined. The stalk height refers to the height of a "topped" plant. The height of topping was in some measure determined by judgment from a commercial standpoint in earlier years, but in the later years the plants were topped uniformly with reference to the position of the first "bald" sucker. The leaf number is the number of marketable leaves. The length and breadth of the leaves are the maximum measurement of these dimensions. The "top leaf" is the uppermost leaf of the plant after topping, the "middle leaf" the largest leaf selected at random at about the middle position of the plant and the "bottom leaf," usually the third from the bottom counting in the "sand" leaves. The average leaf length and width is the average of the top, middle, and bottom leaf, and represents quite satisfactorily the average size of the leaves on the plant. The average breadth-index is secured by dividing the average leaf breadth by the average length and multiplying by 100. This figure is a good relative index to the shape of the leaf, *i. e.*, it indicates the width as compared to the length, the greater the number the more nearly

AN IMPROVED WISCONSIN STRAIN OF TOBACCO

"Connecticut Havana No. 38," a strain produced by crossing two strains isolated from the common Connecticut Havana variety. This type of tobacco has been a commercial success, and is a noteworthy example of the practical possibilities of plant breeding. (Fig. 9.)

THE SECOND PARENT OF CONNECTICUT HAVANA NO. 38

This tobacco plant represents Strain No. 27, isolated from the Connecticut Havana variety. It was used as the male or pollen-bearing strain in making the cross which produced the commercially valuable type known as Connecticut Havana No. 38. (Fig. 10.)

TABLE I.—*Data for Leaf Number, Size, and Shape, and for Height of Plants of Connecticut Havana No. 38 in Comparison with Parent Plants and a Normal Strain for Years* 1909–1918

Year	Designation	Average of number of plants measured	Stalk height	Leaf No.	Top leaf		Middle leaf		Bottom leaf		Leaf averages		Average
					Length	Width	Length	Width	Length	Width	Length	Width	Breadth-index
1909	26(P1)	25	30.1	16.1	15.7	7.7	....	....	17.8	12.0	16.7	9.8	58.8
	27(P2)	25	31.3	18.2	12.0	5.2	....	....	15.7	10.9	13.8	8.0	58.0
	33	25	32.0	16.8	14.2	6.8	....	....	16.2	10.8	15.2	8.8	57.8
1910	38(F1)	20	31.1	18.6	12.4	7.4	....	....	17.3	12.4	14.8	9.9	66.0
1911	263	17	31.0	15.1	15.3	8.7	23.1	14.3	19.0	12.8	19.1	11.9	62.3
	274	18	36.3	19.1	16.1	7.6	21.4	11.9	17.7	11.6	18.4	10.3	55.9
	381(F2)	46	29.2	16.8	15.5	7.8	21.2	11.6	17.9	11.9	18.2	10.4	57.1
	333	15	27.8	15.9	15.0	7.4	20.0	10.7	15.4	11.1	16.8	9.7	57.7
1912	26302	15	28.0	14.2	19.9	10.0	25.6	13.2	19.0	11.3	21.5	11.5	53.4
	27402	25	35.0	17.9	18.3	8.3	23.0	12.6	18.0	10.8	19.8	10.6	53.5
	383(F2)	25	32.8	17.1	20.3	9.2	24.9	12.9	19.2	11.1	21.5	11.1	51.6
	33304	25	31.2	16.1	18.7	8.4	23.7	12.3	18.3	10.0	20.2	10.2	50.5
1913	26	25	31.5	15.1	21.8	12.0	26.0	14.4	18.0	11.5	21.9	12.6	57.1
	274021	25	32.9	17.5	20.6	9.7	24.7	13.1	17.0	11.0	20.8	11.3	54.3
	38(F1)	50	33.8	17.0	20.5	10.3	25.6	13.2	17.6	10.9	21.2	11.5	54.2
	333042	15	33.3	15.4	20.8	10.4	25.4	13.7	17.2	11.2	21.1	11.8	55.9
1914	2740211	25	29.9	18.0	15.5	7.5	20.8	10.6	15.9	10.7	17.4	9.6	55.1
	387(F2)	25	30.0	16.0	16.0	7.7	22.1	11.2	15.5	10.6	17.9	9.8	54.2
	3330422	25	29.0	15.4	15.0	7.4	21.3	10.8	15.6	9.6	17.3	9.3	53.7
1915	26301	25	24.4	12.9	17.0	8.7	24.0	12.6	18.9	11.1	20.0	10.8	54.0
	27402112	25	25.8	16.5	16.7	7.4	22.1	10.4	16.8	9.2	18.5	9.0	48.6
	386(F2)	25	23.2	16.2	18.6	8.3	22.9	11.6	18.4	10.9	20.0	10.3	51.5
	33304222	25	27.7	14.9	15.8	7.5	21.7	10.8	16.8	8.4	18.1	8.9	49.1
1917	263016	25	29.0	12.2	17.9	9.6	24.8	13.6	17.3	10.5	20.0	11.2	56.0
	274021121	25	37.4	18.0	14.1	6.7	21.8	11.5	16.5	9.5	17.5	9.2	52.5
	3862(F3)	25	34.7	15.8	16.4	9.0	24.7	14.1	17.2	11.1	19.4	11.4	58.7
	33304221	25	31.4	13.8	17.1	8.9	23.9	12.7	16.2	10.0	19.1	10.5	54.9
1918	2630161	25	31.5	13.8	19.8	9.4	27.4	14.2	16.9	10.1	21.4	11.6	54.2
	2740211214	25	39.2	19.2	14.7	6.1	24.6	12.4	14.4	8.5	17.9	9.2	51.4
	38621(F4)	25	35.5	17.3	18.2	8.6	26.9	14.2	15.6	9.6	20.2	10.8	53.4
	3330422214	25	32.0	16.0	17.1	8.0	24.1	12.8	13.0	7.2	18.1	9.3	51.3

"round" the leaf. From these data it will be seen, by comparing the averages of No. 38 with those of No. 33 (the ordinary Connecticut Havana), that the number of leaves is on the whole greater and the average leaf size somewhat larger in the Connecticut Havana 38. The leaf shape is also considerably better under good growing conditions, though this character is less pronounced than other characters under unfavorable growing conditions. The more significant facts are summarized as averages of eight years in Table II.

The value of this strain is shown by the fact that in addition to the seed distributed by the station, at least four growers are producing the seed for commercial purposes in one instance on an extensive scale. *It is estimated that at least ten thousand acres of this type will be grown in Wisconsin during* 1919, *out of a total acreage of forty to forty-five thousand. This is, then, a case of a new strain of tobacco developed as a result of experimental trial which has been accepted and grown commercially.* There have been perhaps a number of such failures in tobacco culture leading to the popular opinion among growers and dealers that tobacco cannot or should not be "bred up," but that we should strive to maintain the "original" as closely as practicable, separating our seed by as few generations as possible from the original stock of seed upon which the success of the tobacco industry was founded. The fallacy of such an argument is evident from an agricultural standpoint, although at the same time one cannot argue too strongly against the promiscuous introduction of new strains of tobacco without having first repeatedly tested them out under the commercial conditions for which they are intended. Much progress can be made along the line of improving tobacco by breeding or selection, but it should not be attempted by anyone who is not willing to devote at least eight to ten years of time and work to accomplish it.

TABLE II.—*Summarized Data of Most Significant Characters of Connecticut Havana No. 38, Together with Parent and Normal Strains. Averages of eight years.*

Strain	Leaf number	Average of top, middle, and bottom leaves		Breadth index of leaf
		Length, inches	Width, inches	
No. 26	14.2	20.0	11.3	56.5
No. 27	18.0	18.0	9.6	53.6
No. 38	16.9	19.1	10.6	55.8
No. 33	15.5	18.2	9.8	53.8

Notice to Readers

Attention is invited to the footnote on the title page, in which it is stated that the JOURNAL is published monthly with the exception of July, August and September. The omission of these three numbers was made necessary last year by war conditions, and the fact that the entire editorial staff had entered the military service and left the magazine in the hands of volunteer workers, making the issuance of the summer numbers impracticable.

It is considered advisable to pursue the same policy this year, but the editorial staff has recently been reorganized, and with the appearance of the October issue it is expected that the JOURNAL will return to its pre-war basis of twelve issues a year.

The JOURNAL relies upon members of the American Genetic Association for interesting material upon subjects falling within its scope. Members are cordially invited to submit articles suitable for publication, especially those which are illustrated with striking or unusual photographs. It is a particular policy of this publication to interpret the discoveries of modern science by means of photographs.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. X, No. 7 October, 1919

CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918 and 1919. Vol. IX contains only 8 instead of 12 numbers, as will also Vol. X.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.

Date of issue of this number, October 15, 1919.

DIFFERENT FORMS OF TIMOTHY

The *aftergrowth* or development of the plants after cutting is shown by these four clumps, which were cut on June 28 and photographed September 2. "The quantity of the aftergrowth is to a large extent due to more or less favorable conditions of weather, but also to different forms. Some forms yield exclusively leaves, others leaves and stems, and others again nothing but single stems." The tall plant on the left is referred to in the text as *a*, the one next to it *b*. (Frontispiece.)

BREEDING TIMOTHY AT SVALÖF

Hernfrid Witte

Director of the Forage Plant Section of the Swedish Seed Association

MY INTENTION in presenting the following report is to give a short account of the methods of timothy breeding at Svalöf, the multifariousness of forms studied, and the results gained from this branch of breeding up to the present time.

The Meadow culture in Sweden is of high importance, about one-third of the open area being occupied by meadows, most of which are temporary. Sweden's annual want of clover and grass seed amounts to about 11 millions of kilograms, of which not less than 4.8 millions is Timothy seed. In the year 1907, when grass breeding work was taken up at Svalöf, timothy was the first to be made an object of investigation; but also orchard grass (*Dactylis glomerata*), meadow fescue (*Festuca pratensis*), tall oat grass (*Avena elatior*), perennial ryegrass (*Lolium perenne*), field bromegrass (*Bromus arvensis*) and several others were added.

THEORY AND METHODS OF BREEDING TIMOTHY

Timothy normally being cross-pollinating and exhibiting manifold variations in nearly all its characters, appears in an infinite number of different forms, though only a very few of them are fully constant, giving a uniform progeny after self-fertilization. Suppose, for instance, that twenty-five different pairs of characters (surely a far too low number) are represented in timothy, this certainly means that $(2)^{25}$ or 33 million constant combinations may exist, but the number of possible combinations, amounting to $(2^{25})^2$ or about 1.126 milliards, means only one perfectly constant individual in 33 millions. It is therefore practically impossible to base timothy breeding on selection of constant individuals. Instead one has to select a great number of individuals, to study the practical value of the progeny of each of them—if possible, in several generations. It may be necessary to repeat the selection before at last introducing to agriculture the variety or varieties that have proven to be of the highest practical value.

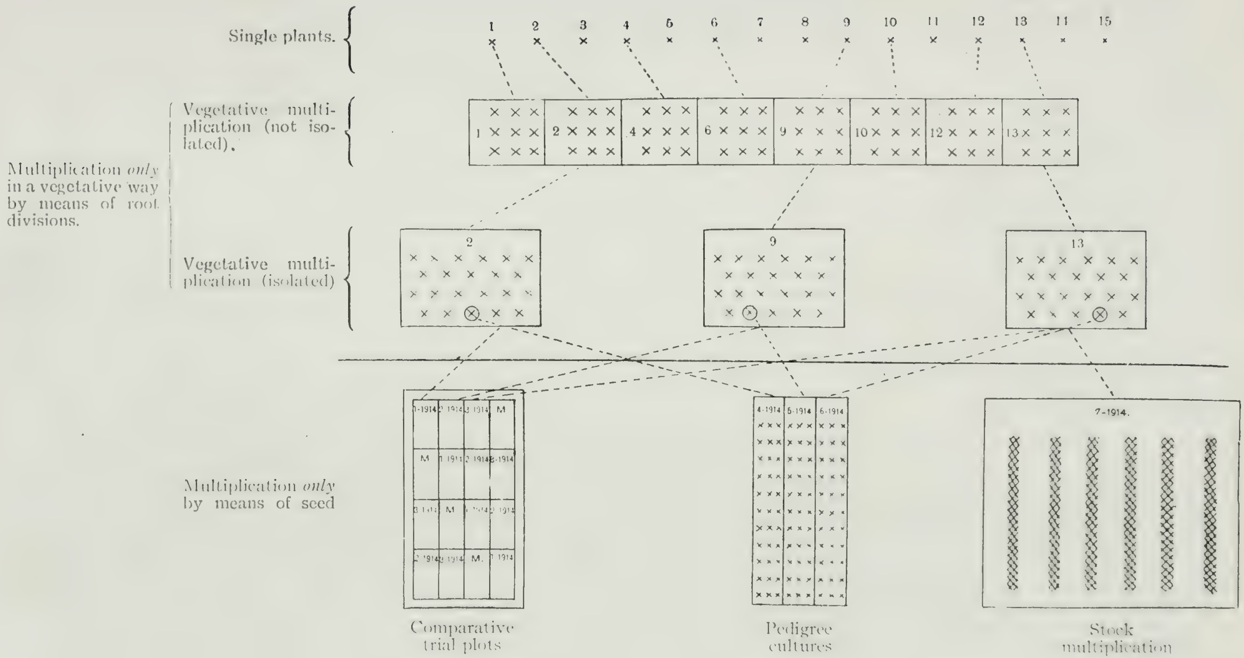
The practical method used at Svalöf in breeding perennial grasses appears from the following scheme. From nature, or from cultures at Svalöf, pedigreed plants are selected and vegetatively multiplied in plots for the purpose of attaining the truest possible estimate of different characters desired. The best of these plots are then reincreased vegetatively into larger plots, situated as solitarily as possible. This is marked on the chart "vegetative multiplication isolated." With seeds from the last-mentioned plots comparative trial plots are laid out, and when in several trials a sort has proven practically superior to the very best commercial seed, and also has afforded evidence of practical uniformity, it may be multiplied and distributed on a large scale. Uniformity is studied in special pedigree plots where the plants, raised from seeds obtained in artificial isolation, are growing in like distances each way, generally 40 cm. In these pedigree trials new selections are made—individual as well as mass selections.

VARIATION AND HEREDITY OF DIFFERENT CHARACTERS

The length of stem varies remarkably, from 20 to 30 cm. on the one hand to 110 to 120 cm. on the other (see Figs. 1 and 5), and displays a series of hereditary gradations, though at times it may be difficult distinctly to state the hereditariness of the separate gradations, since modifications from the environment are rather considerable.

TWO EXTREMES IN HABIT OF GROWTH

These plants illustrate the remarkably wide range of variation which occurs among timothy plants in habit of growth. (Fig. 1.)



Single plants.
1
2
3
4
5
6
7
8
9
10
11
12
13
11
15
Vegetative multiplication (not isolated).
Multiplication only in a vegetative way by means of root divisions.
Vegetative multiplication (isolated)
2
9
13
Multiplication only by means of seed
M
7-1914.
Comparative trial plots
Pedigree cultures
Stock multiplication

Number and Length of Internodes.—As a rule most types possess 6 or 7 internodes, seldom 5. Concerning the length of the different internodes the top internode is always the longest. The length decreases downward, so that the base internode normally is the shortest.

Comparing different forms, the lengths of the internodes vary, absolutely speaking, to a considerable extent, a fact that causes the various length of stem in various forms. Not only absolutely but also relatively considered, the length of the internodes is varying to the extent that the relation between the different internodes in this respect is rather different in different forms. The top internode may, for instance, in some forms be longer than half the stem's length, whereas in others it hardly equals one-fourth of the whole length. The base internodes are in certain cases very short, in others rather long (see Fig. 3). In this respect the modifications are remarkable, but regarding the length of the internodes there exists, no doubt, a wide range of hereditary gradations.

Thickness of Stem.—As a matter of course there generally exists between tall and short stem-forms rather great differences in thickness, a fact, however, that also may be noticed between forms of about the same height, so that length and thickness of stem are not always correlated. The thickness of stem is naturally an hereditary character.

Direction of Stem.—In most timothy forms the stems are stiffly erect, in some, however—for instance, in several dwarfed varieties—they are more or less spreading, but mostly they have a comparatively irregular direction, varying from erect to spreading or at least a tendency towards spreading (see Figs. 1 and 5). In other varieties the stems are decidedly spreading, sometimes making an angle of only 30 degrees with the horizontal level (Fig. 1*b*). Direction of stem is an hereditary character and has a practical bearing.

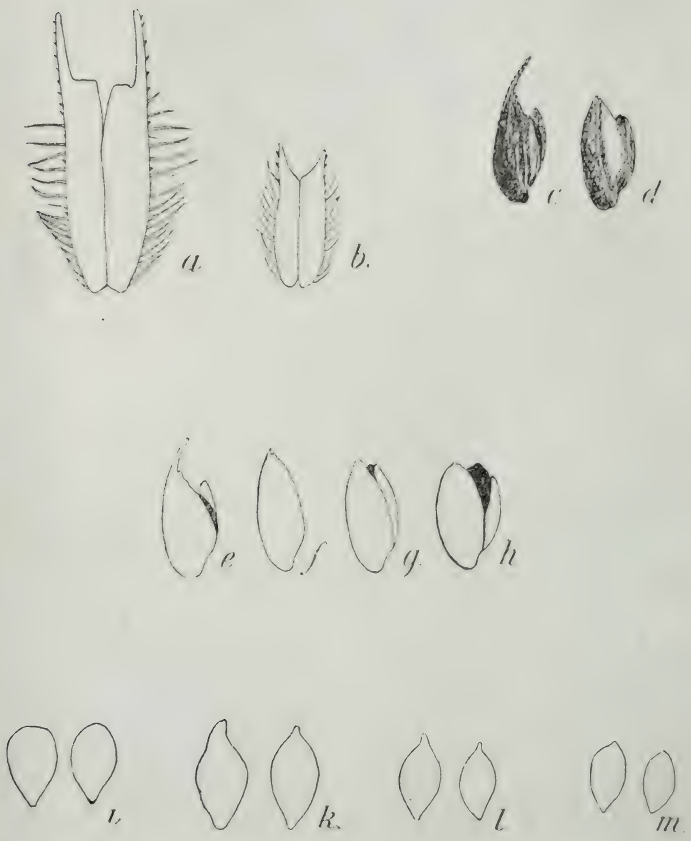
Size and Color of Leaves.—In width and length as well as in their mutual relations the leaves vary considerably. The middle leaves, which are the largest, may in different forms vary in width from 4.6 to 10.6 mm. and in length from 55 to 276 mm. The relation between width and length of leaves is subject to a wide range of variation; the length of the middle leaves varies in different forms from 14 to 40 times the width. Thus there exist many combinations of gradations that certainly are hereditary, though it is very difficult to arrive at a definite conclusion in this respect. The leaves may also be flat or more or less boat-shaped.

As to direction of leaves, in most forms the leaves are drooping, in some nearly erect. The color of the leaves varies from pale green to dark or bluish-green. The stems are normally yellow-greenish; at times the upper internodes may be rather intensely anthocyan or bluish colored.

Variation of Head.—The head is subject to marked variations in length, thickness, shape, stiffness, compactness, etc. (see Fig. 3). Length and thickness of the head change markedly. No correlation exists between these characters, as in two variations of like length of head the thickness may differentiate considerably, and vice versa. It may be stated that the length of head varies from 2 to 15 cm. and the thickness from about 3 or 4 mm. to 8 or 10 mm. Different gradations of size of head are obviously hereditary. The shape of head is normally cylindrical, occasionally with tapering apex or base, rarely fusiform, all of these characters being surely hereditary. As a rule the head is stiff, occasionally slender and nodding.

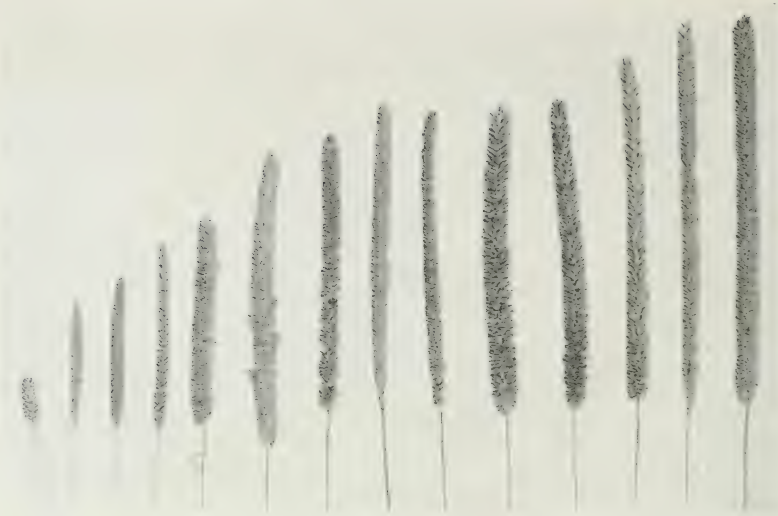
In the typical timothy head the rachillae are reduced to such an extent as to give the 1-flowered spikelets the appearance of growing out directly from the spike axis; in exceptional cases the rachillae are elongated, making the spike more panicle-shaped. Also these characters are hereditary (see Fig. 3).

Variation in Flower Parts.—The empty glumes vary in size from 2.5 or 3 mm. to 5 or 5.5 mm. in length (see frontispiece *a*, *b*) as well as in color at



GLUMES AND SEEDS

A detailed representation of the variations which occur in the glumes and seeds of timothy. *A* and *b* are empty glumes; *c* to *h* floral glumes, and *i* to *m* seeds of different forms. *A*, magnified several diameters. (Fig. 2.)



VARIATION IN TIMOTHY HEADS

This series of heads represents the range of variation which has been obtained during the course of the breeding work at Svalöf. "The length of head varies from 2 to 15 cm., and the thickness from about 3 or 4 mm. to 8 or 10 mm. Different gradations of size of head are obviously hereditary." (Fig. 3.)

bloom and maturity. The floral glumes are also subject to variability as to form, size and color. Normally the first floral glume is awnless, occasionally having a small awn (see Fig. 2, *c–h*). The anthers vary in color from white to intense violet, sometimes rust-brownish. The grains present variations in form (roundish or pointed), color (light to dark brown) and size (see Fig. 2, *i-m*).

Physiological Characters.—Regarding hardiness no difference between various forms has been noticed at Svalöf, but in the northern part of Sweden, at the branch station of the Swedish Seed Association at Lulea, Lat. 65° 35′ N., marked variations in this respect have been noted.

Different timothy forms present a noticeable variation in earliness of shooting culms in spring time as well as in earliness of bloom (see Fig. 5). The beginning of the bloom time may differ with twenty-five days between the earliest and the latest forms. These characters are anyway not correlated, but hereditary. Stiffness of stem appears to vary as in the cereals and is also hereditary. Withering down of leaves is an hereditary character that may be very pronounced. In some forms all the leaves may be withered at the beginning of the bloom; in others they may be almost fresh even at the ripening of the seeds.

Aftergrowth.—The quantity of the aftergrowth is to a large extent due to more or less favorable conditions of weather, but also to different forms. Some forms yield exclusively leaves, others leaves and stems, and others again nothing but single stems (see frontispiece). As to stooling power there is a wide range of variation in different forms.

Disease Resistance.—The resistance against the timothy rust (*Puccinia phleipratensis*), the fungous disease that most severely attacks timothy, varies considerably in different forms. Some forms are so intensely affected that rust appears even in the empty glumes,

DIFFERENCE IN RUST-RESISTANCE

These two plants were photographed in the spring of the year. The one on the left was not affected by timothy rust the previous season, while the one on the right was seriously affected. Variations in resistance to rust are inherited. (Fig. 4.)

THREE DISTINCT STRAINS

The plant on the left represents a tall and early-maturing strain of timothy produced at Svalöf; the one in the center is medium-sized and moderately early; and the one on the right is medium-sized and very late. (Fig. 5.)

whereas other forms growing close by may be left nearly intact. The practical importance of this hereditary character should not be overlooked, as severely diseased individuals evidently decrease in yield the following year (see Fig. 4), or occasionally even are killed out by the attacks. There are also other fungous timothy diseases as, for example, *Scolecotrichum graminis*, *Epichloe typhina* and *Dilophia graminis*, but the power of resistance against these diseases has as yet not been a subject of investigation.

Resistance to aridity also displays variations, some dwarfed forms with reduced transpiration surfaces being more suitable for adaptation to dry conditions.

Specific longevity is no doubt in-

herently varying in different forms, though it is difficult to make an exact statement on account of the variability in external conditions.

WHICH CHARACTERS ARE MOST DESIRABLE?

Evidently all characters in timothy are more or less subject to variation, but all gradations of characters are combined in nearly infinite numbers of different forms. Most of these are hybrids, at self-fertilization yielding an offspring more or less uniform, splitting up in different types. To produce perfectly constant timothy sorts is practically impossible. Breeding work, therefore, demands that one should chiefly eliminate characters of a purely theoretical interest and endeavor to gain the highest possible uniformity concerning practical characters.

A timothy sort for ordinary 2-years lay should possess:

1. Tall, not too stout, erect, comparatively stiff stems with short top internodes and relatively long base internodes.
2. Vigorous, abundant stooling power.
3. Profusion of leaves, perfectly fresh at cutting.
4. Rich aftergrowth.
5. Satisfying hardiness.
6. Highest possible resistance against rust.
7. Convenient earliness.
8. Good development during the second yielding year.

A timothy sort for perennial pasture should possess:

1. Vigorous stooling power.
2. Early and abundant aftergrowth after each grazing.
3. Satisfying hardiness.
4. Highest possible resistance to rust.
5. Highly increased longevity.

As a matter of course a high yield of hay is the chief goal in timothy breeding, but the importance of combining a good seed production must not be overlooked. For this purpose the following characters are requisite: First, tall, stiff, compact, uninterrupted heads; second, big, plump, well-colored seeds, easily loosening from empty glumes and with well-fastened floral glumes; and third, high ability of self-fertilization.

ACTUAL PRACTICAL RESULTS AT SVALÖF

After the year of 1909 comparison trials have been made with manifold sorts selected at Svalöf, but space is too limited for an account thereof. On a basis of the above trials the two following new sorts have been raised, introduced, and distributed, namely, Primus timothy and Gloria timothy. These sorts have in trials at Svalöf afforded respectively 12 and 20% higher yield than ordinary Swedish market seed, thus indicating a marked progress. The above sorts are resistnat to rust and are high yielders of seed.

Yield of Different Timothy Sorts in Trials at Svalöf, 1909–1918

	Kilograms of green fodder per hectare			
	First year's lay	Second year's lay	Total	Yield % compared to ordinary Swedish timothy
Svalöf's Gloria timothy	14.480	11.030	25.510	120.6
Svalöf's Primus timothy	13.460	10.210	23.670	111.9
Ordinary Swedish timothy	11.570	9.590	21.160	100.0

GENIUS OF THEODORE ROOSEVELT AND HIS PLACE AMONG HISTORIC PERSONALITIES

Frederick Adams Woods

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NOW that Theodore Roosevelt has passed away, the whole world is ready to acclaim what only a small faction formerly perceived, that this extraordinary man was not only one of the greatest of all Americans, but was in his characteristics and conduct essentially a man of genius.

The general unwillingness or inability to justly estimate our former national leader arose from several causes by no means unique in his case, but rather the exemplification of the eternal relation of the man of genius to the men whom he seeks to persuade.

If the pioneer is a man of science or an artist, he has his small group of doubting professional colleagues who need to be shown the way. If the artist or scientist has found a new truth, it is not usually long before this is accepted. Such men, if they be really great and live to a ripe old age, are almost sure to receive phenomenal recognition before they die. Names swell into memory to support such a view: Newton, Boyle, Darwin, Lister, Kelvin, Ramsay, Franklin, Rumford, Pasteur, Cuvier, Fabre, Linnaeus, Lagrange, Laplace, Tycho Brahe, Goethe, Kant, Helmholtz and Faraday, Titian, Michael Angelo, Raphael, Leonardo, Rubens, Van Dyke, Holbein, Durer, Millet, Corot, Whistler, Hogarth, Reynolds and many others, all received, if not ample, at least very distinguished recognition during their actual lives. There are exceptions. Copernicus was long unappreciated, Galileo had a hard time, and Mendel was unknown until years after his death. Manet, the founder of impressionism, was only in part appreciated. He died at the age of fifty—a recipient of the Legion of Honor. William Blake lived to be seventy, too long for his own happiness. He died in poverty and obscurity. There have been other martyrs to science and art. It is perhaps the popular conception of the typical man of genius that he is unrecognized in his day. But this is not the truth of the matter. It is like many other popular misconceptions, built upon the almost unavoidable tendency to note and remember the unusual and thus mistake the exception for the rule. Scientists, artists and musicians, even if bringing the best of news, all require time for its acceptance. The experts and the critics must be convinced; after that the public are easily made to follow on gregariously. There comes a day when opposition is negligible. Not so with the political genius. He always has to face a mighty opposition even to the day of his death. It lies in the nature of political and party bias and is inherent in the kind of work that is his. "A fight from start to finish," but there never is a finish, never was, nor can there conceivably be a finish, where the particular form of manifestation of genius is the leading of human groups. For there will always remain a very formidable aggregate of humans who, rightly or wrongly, even if it be a truth, cannot be made to see it that way.

It is essentially a different kind of problem, for here truth is not absolute and "right"—is always related to somebody's best interests. Even if it be made into the phrase, the "best interests of all," it will be impossible to bring all parties into agreement,

since the dispute will then arise as to the best methods of bringing about this desirable "best interests of all." The "politician" in life may in death become the "statesman," but his theories and his weaknesses are always more exposed to searching criticism than is the case in other forms of genius.

In the light of these considerations, and measured in comparison with other great men, the faults, inconsistencies, or weaknesses of Theodore Roosevelt appear inconsiderable, while the astonishing and versatile attainments place him easily among the first hundred and fifty of the world's most wonderful men. Take alone the physical or (perhaps better) physiological aspect of his personality. How seldom do we meet with people who have the constantly impelling vital force that Roosevelt had, who are always animated, always inspiring, always talking, or writing, or transforming thoughts into actions—always "feeling bully." If this sort of activity is, as modern physiology would lead us to believe, dependent upon an excessive amount of certain peculiar internal secretions, then, on the bodily side alone, Roosevelt must have been extraordinary. Although a man of action and known chiefly for his deeds and his relations with his fellow-men, the total output of his literary product, *i. e.*, his published work, exceeds that of any other Harvard man of his day.

Men of such constant exuberance of spirit, while rare, are not exceedingly uncommon. We all meet them from time to time, chiefly in the business world. They make good promoters. But do we often meet a man of that stamp who is also possessed of one of the most remarkable memories ever given to any human being? If we do, he is as one man in a million. There may be a hundred such persons in the United States today. But of these how many also are endowed with a high moral sense, with a never-failing desire to make the world over in the ways that seem for them unquestionably right? There are such men. History knows them. They are very few in number. They are famous. Some of them have been celebrated as preachers and reformers.

Now let these three traits, the first two of which are so rare, the third of which is not too common, be united with intellectual curiosity, leading to a variety of interests, which in time become coördinated into a broad outlook, and we have our rarer man still—one so rare that not a hundred and fifty men in all history outrank him in fame or eminence. And this is including all forms of activity—that of the painter, the poet, the preacher, the sculptor as well.

Gladstone may rank with Roosevelt or he may outrank him. Disraeli, Franklin, Pitt, Cromwell, Clive, William the Conqueror, Peter the Great, Pericles, Charlemagne and Julius Caesar may rank with Roosevelt. They may far outrank him. Doubtless some of them do. But the point is that there are so few of these very great names that before we reach the end of the first hundred and fifty we *willy-nilly* are obliged to include names that certainly do not suggest any more genius or any more greatness than that of Theodore Roosevelt. Let any reader try it for himself and get his friends to help. If he does not, before finishing his first hundred and fifty, then I wager that before finishing his second hundred, he will only be able to bring forward names of a somewhat secondary magnitude. The dazzle will be gone. At least Roosevelt will come in here somewhere.

In any estimate of genius it is well to have some objective standards of comparison and a list of names as inclusive as possible of all candidates for selection. Such a list can never be entirely satisfactory, but it is at least better than no list, since otherwise many suitable names would be overlooked. No list has been formulated attempting to grade great men according to their "pure genius," but there is a useful and suggestive list of "eminent" men based upon encyclopedias and biographical dictionaries. It was compiled by J. McKeen Cattell and published in *Popular Science*

Monthly, February, 1903. Here a thousand historical characters are graded according to their "eminence," in other words with reference to the amount of attention that they now attract. Such a method of comparison is obviously faulty as a test of mental merit, since it places Louis XVI, Philip II of Spain and George III of England in the first hundred. Also Nero, Robespierre, Mirabeau, and Bossuet seem out of place, nearly at the top of the heap. If we search down through the lower rankings we find some, though not proportionately many, of undoubted geniuses who ought to go higher up, such as Wagner, Copernicus, Kepler and Bach. Now if we substitute these for the misplaced names in the first hundred according to our choice, allowing for all differences of opinion, we do not change the character of the second hundred to any appreciable extent.[1]

The leading names of Americans are in order of eminence: Washington, Penn, Lincoln, Franklin, Jefferson, Grant, John Adams, Webster, Hamilton, Jackson, Longfellow, Prescott, Irving, Emerson, Madison, Farragut, J. Q. Adams, Hawthorne, Cooper, Rumford, Clay, Patrick Henry, Fulton, Sumner, Sheridan, Monroe and Audubon.

Washington, Penn, Lincoln, Franklin and Jefferson are in the first hundred, Grant, John Adams and Webster are in the second hundred, Alexander Hamilton and Andrew Jackson are in the third.

The place of Roosevelt in world history from the standpoint of genius seems to be, by this test, fairly well indicated. He certainly cannot go much below the second hundred, not if he be the equal of Hamilton or Jackson. If his genius were greater than that of John Adams or Webster or Grant, he may go in the first hundred; if greater than either Jefferson or Penn, then he might go well up in the first hundred. At any rate the probability is that there have not been more than one hundred and fifty men of eminence or of genius greater than Roosevelt in all recorded time.

[1] My own suggestion is that the following names do not deserve a place in the first hundred. They should be placed somewhat lower, and room thus made for the names of very great men who have obviously been graded too low: Penn, Byron, Nero, Robespierre, Charles V of Germany, Mirabeau, Guizot, Bossuet, Thiers, Louis XIV, Fox, Machiavelli, Philip II of Spain, George III, Cousin, and Justinian. Some of these might be placed in the second hundred, some much lower. The second hundred might also be improved by the removal to lower grades of certain names as, for instance: Fénelon, Pius IX, Charles I of England, Lamartine, Joseph Bonaparte, James I, Alberoni, Louis XIII, Diderot, Marmont, Francis I, Nicholas I, Athanasius, Bentley, J. Cook, and Louis XV.

A DEFECT OF HAIR AND TEETH IN CATTLE - PROBABLY HEREDITARY[1]

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University of Wisconsin

IN THE spring of 1918 Prof. Arthur H. Kuhlman, of the State College, Brookings, S. D., at that time Agricultural Demonstration Agent at Juneau, Wis., brought to my attention an interesting case of dental deficiency in cattle. This was in a herd of purebred Holstein-Friesians near Juneau, and a short time later I was able to visit the place with Mr. Kuhlman and to secure some photographs and notes relating to the case. As the condition appears to be unusual, and as it shows evidence of being hereditary, it seems worth while to put it on record.

The defect was first noticed when some of the calves born early in 1918 were being taught to drink by putting the fingers in their mouths for them to suck. It was discovered in this way that three of them did not have well-formed teeth in front like normal calves. Furthermore, these same calves had a peculiar deficiency of hair, which will be mentioned more in detail later. The discovery of this condition in the calves recalled the fact that the bull which sired them had, when about a year old, been turned out on pasture with other cattle, and that he had grown thin while the others remained in good flesh. An examination was accordingly made of his mouth, leading to the discovery that instead of the normal complement of four well-formed incisor teeth on each side, in the front of the lower jaw, he had only three small, imperfect teeth on the left side and two correspondingly small ones on the right. These were so small as to be practically useless for cropping grass, which readily explained the bull's failure to do well on pasture. As may be seen, however, from Fig. 6, he was a well-developed, fine appearing animal. It was not practicable to secure a picture of his mouth showing the teeth.

This bull had been purchased of another breeder, and was coming three years of age at the time of our visit. Until his mouth was examined, it was not known that he was in any way imperfect or abnormal. The dams of the calves, so far as known, all had normal dentition.

Of the three defective calves of 1918, one had two small teeth on the left and one on the right, the second had one very small tooth on the left and one small one on the right, while the third (shown in Fig. 7) had two conical teeth on each side, the back ones being very small while those in front were larger but round and blunt. The contrast with the normal dentition in a calf of this age may be readily seen by comparing this figure with Fig. 8. Here the four sharp, well-developed teeth are plainly discernible.

Associated with the deficiency of teeth there was also a deficiency of hair. This was said to be quite noticeable in the very young calves, especially on the head and neck. The hair was not entirely lacking on these parts, but was very short, giving a semi-denuded appearance. Later in life the coat appears to be practically normal. At the age at which our photographs were taken the difference was easily noticeable, but it does not, unfortunately, stand out very clearly in the pictures. By careful scrutiny, however, it may be observed that the head and upper neck

[1]Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 19. Published with the approval of the Director of the Station.

ONE PARENT OF THE DEFECTIVE CALVES

This pure-bred Holstein-Friesian bull sired in two seasons five calves with defective coats. Three of them also possessed defective teeth. (Fig. 6.)

A PECULIAR DEFECT

The calf whose mouth is here seen was sired by the Holstein-Friesian bull shown in Fig. 6. The incisor teeth, only two of which are to be found on each side, are conical and blunt. Compare them with the teeth shown in Fig. 8, which are those of a normal calf sired by the same bull. (Fig. 7.)

NORMAL DENTITION

This calf's teeth are normal, though it was sired by the same bull (see Fig. 6) as the calf with defective dentition shown in Fig. 7. There are four sharp, well-formed incisors on each side in the front of the lower jaw. (Fig. 8.)

A DEFECTIVE COAT

This calf is the same one whose mouth, with defective dentition, is shown in Fig. 7. The smoothness of the coat on the head and upper neck is due to the very short hair on these parts. This characteristic is probably correlated with defective dentition, and appears to be inherited. (Fig. 9.)

A NORMAL COAT

Head of the normal calf whose mouth is shown in Fig. 8, for comparison with the defective calf shown in Fig. 9. The contrasting length of the hair on the head is visible where it overlaps the halter strap behind the lower jaw. (Fig. 10.)

of the calf shown in Fig 9, the same animal as that in Fig. 7, is noticeably smoother than that of the calf in Fig. 10, the same individual used for comparison of the teeth in Fig. 8. Note, for example, how the hair at the angle of the lower jaw overlaps the halter strap in Fig. 10, showing that it is considerably longer than on the other calf. The coat also seemed thicker, but I cannot make a definite statement as to this.

Two calves born in the herd the previous year, and from this same sire, resembled the one described above in having a deficiency of hair, but no examination was made of their teeth, the correlation of the two at that time not being suspected. Whether the bull when young was similarly deficient in hair was not known.

To sum up, a purebred Holstein-Friesian sire with defective front teeth, bred to purebred Holstein-Friesian cows, produced in two successive years five calves with deficient coats, three of which are known to have had defective dentition corresponding to the condition of the sire. In the same season this bull sired some fifteen or twenty normal calves from dams in the same herd. There would appear to be a correlation between the condition of the coat and the deficient and defective teeth. Furthermore, since the bull was not born on the place, and all the calves, normal as well as defective, were reared under similar conditions, it seems probable that the condition is to be attributed to some genetic cause rather than to factors of the environment or to faulty nutrition. It is probably not comparable, for example, to hairlessness in new-born pigs, which is referable to thyroid conditions due to deficiencies in the diet of the sow. The question of the inheritance of the condition in the calves could not be carried further, as it was the intention of the breeder to eliminate all the defective stock from his herd.

A NEW SOURCE OF PLANT FOOD

"THE use of leguminous crops for soil improvement," writes Karl F. Kellerman, "has long been recognized by good farmers as desirable. Aside from the general benefits of crop rotation, the actual soil-enrichment is due largely to an accumulation of available nitrogen, and this gain in nitrogen is caused by the presence of minute soil-bacteria which possess the power of growing on the roots of the legumes and then utilizing or 'fixing' the free nitrogen of the air and converting it into food for succeeding crops."

North American farmers have become quite familiar with these nitrogen-gathering leguminous plants, and they play an important part in the cultivation of numerous crops. Cow-peas, velvet-beans, vetches, and other legumes are sown between rows of fruit trees and plowed under when they begin to bloom, in order that the nitrogen which they have gathered in the small nodules upon their roots may be utilized by the trees. The use of these green cover-crops lessens the amount of other fertilizer which it is necessary to apply to the orchard.

Attention has recently been called to certain plants which gather nitrogen, like the legumes, but which store it in small nodules on the leaves instead of on the roots. The one of which a leaf is shown in the accompanying illustration is *Psychotria bacteriophila;* it has been shown by Zimmermann and Faber that *Pavetta Zimmermanniana* and probably other rubiaceous plants have the same habit. These plants, which belong to the same family as coffee, are, like the latter, tropical in their distribution.

Faber has shown that these leaf-nodules contain colonies of a non-motile, nitrogen-fixing bacterium which he has named *Myco-bacterium rubiacearum.* These bacteria almost invariably inhabit the micropyle of the young seed, and, when the latter germinates, grow through certain stomata of the young leaves and into the intra-cellular spaces formed in the leaf-tissues around these stomata. Cavities are formed through the growth of the epidermal cells which later close entirely and make bacterial nodules which are deeply imbedded in the leaf tissues. A single leaf may have several dozen of these symbiotic bacterial nodules. Faber was able, by treating the seeds with hot water and a sublimate solution, to kill the inhabiting myco-bacteria, and, later, to infect part of the seedlings grown from these seeds with pure cultures of the bacterium. The artificially infected seedlings grown in soil free from combined nitrogen grew well and remained healthy for four months, whereas those not so infected turned yellowish-white and died in three or four weeks. The plants from unsterilized seeds produced leaves bearing many more bacterial nodules than did those from sterilized seeds which were later artificially inoculated.

In view of the fact that these rubiaceous plants with nodule-bearing leaves occur in many parts of the tropics, and that in India the value of their leaves has long been recognized, and considering the importance of nitrogen-fixing legumes as soil enrichers, the suggestion of Faber that we may have in these trees and shrubs plants of positive agricultural value deserves the serious consideration of tropical planters. If they can be grown as subsidiary crops beneath plantations of rubber, cacao, coffee, or other important tropical cultures, and their leaves allowed to accumulate upon the ground to serve as a mulch and as nitrogenous fertilizer, they may have great value. They differ from the leguminous cover-crops in that they are perennial in habit, and will not need to be replanted every year. It might be possible to prune them severely every year and utilize the clippings as fertilizer. The subject is one which opens up a new field in connection with tropical agriculture, and one which offers remarkable possibilities.

COLONIES OF NITROGEN-GATHERING BACTERIA ON A LEAF

The small dark spots visible on the under surface of this leaf are nodules containing colonies of a non-motile nitrogen-fixing bacterium similar to the one which inhabits the nodules on the roots of leguminous plants, and which makes the peas, beans and vetches valuable as green-manures or sources of plant food. These nodules have been found on the leaves of several tropical plants, and the question arises, Will it not be possible to use these species in the same manner as the legumes? (Fig. 11.)

THE INHERITANCE OF COAT COLOR IN GREAT DANES

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I. HISTORICAL OUTLINE

(*a*) *Description of the Breed.*—The Great Dane is known to all dog breeders as one of the most vigorous of the large breeds. Its origin is somewhat in doubt. Stonhenge (1873), in describing the breed, notes its frequent description under the name of Boar Hound and states that it . . . "does not appear to be a distinct breed, but rather a compound of the greyhound, the mastiff, and the terrier." On the other hand, Leighton (1907) believes that the antiquity of the breed is established by the fact that representatives of a type sufficiently similar to be considered its ancestors are found on early Egyptian monuments. Its more recent history appears to focus mostly on Germany, where it has been given the title of "Deutsche Dogge." For a long time it was, in all probability, crossed with other breeds of large German dogs such as the Hatzrüde, which is a medium-sized dog about intermediate in appearance between the heavy and thickset "dogge" type of the bulldog and the slimmer and less powerful "hund" type. Other somewhat similar varieties with which it may have been crossed are the Saufanger, Ulmer Dogge, and Rottweiler Metzerghund.

But whether the Great Dane be considered as one of the oldest breeds or not really has little influence, from the viewpoint of the present investigation. It is sufficient that for a period of at least fifty years they have been recognized and selected with as great care as have the other breeds of thoroughbred dogs. Their color varieties are distinct and are well established as follows:

(*b*) *Color Varieties of the Breed.*—Stonhenge (*loc. cit.*) records the recognized colors of this breed as follows: "The color resembles that of the mastiff, being brindled or fawn, but sometimes of a bluish slate with blotches of brown." That several additional colors appeared and were recognized within a relatively short time is evident from the description of the orthodox colors given by Leighton, (*loc. cit.*) These are, according to his statement, brindle, fawn, blue, black, and harlequin. In the brindle dogs the ground color may be any shade from light yellow to dark red-yellow, on which the brindle appears in darker stripes. The harlequin should have, on a pure white ground, fairly large black patches which must be of irregular shape, broken up as if they were torn. The standard of the breed also states that, in harlequins, fawn and brindle shades are undesirable.

To reduce these color varieties to a simpler basis from a genetic point of view they may be listed as follows: Black (Fig. 12, No. 3); blue (dilute black) (Fig. 12, No. 6); harlequin (black and white), (Fig. 12, No. 2); brindle (Fig. 12, No. 4)—various shades including a dilute or "blue" brindle (Fig. 12, No. 7); fawn (Fig. 12, No. 5)—various shades including a dilute light, or "dove" fawn (Fig. 12, No. 8).

The fawn is tawny with dark-brown or black muzzle and feet. The dilute fawn has a dull, faded silvery appearance, quite well known to those who have seen such color varieties of rodents as dilute brown mice or dilute sooty rabbits. Fawn is, moreover, easily distinguishable from the yellow of pointers which is a clear, yellow-orange or lemon color, not nearly as rich or heavy in shade as the more brownish

pigmentation of the fawn. The blue is a true dilute type, apparently directly analogous to the maltese cat and the "dilute black" mouse or rabbit.

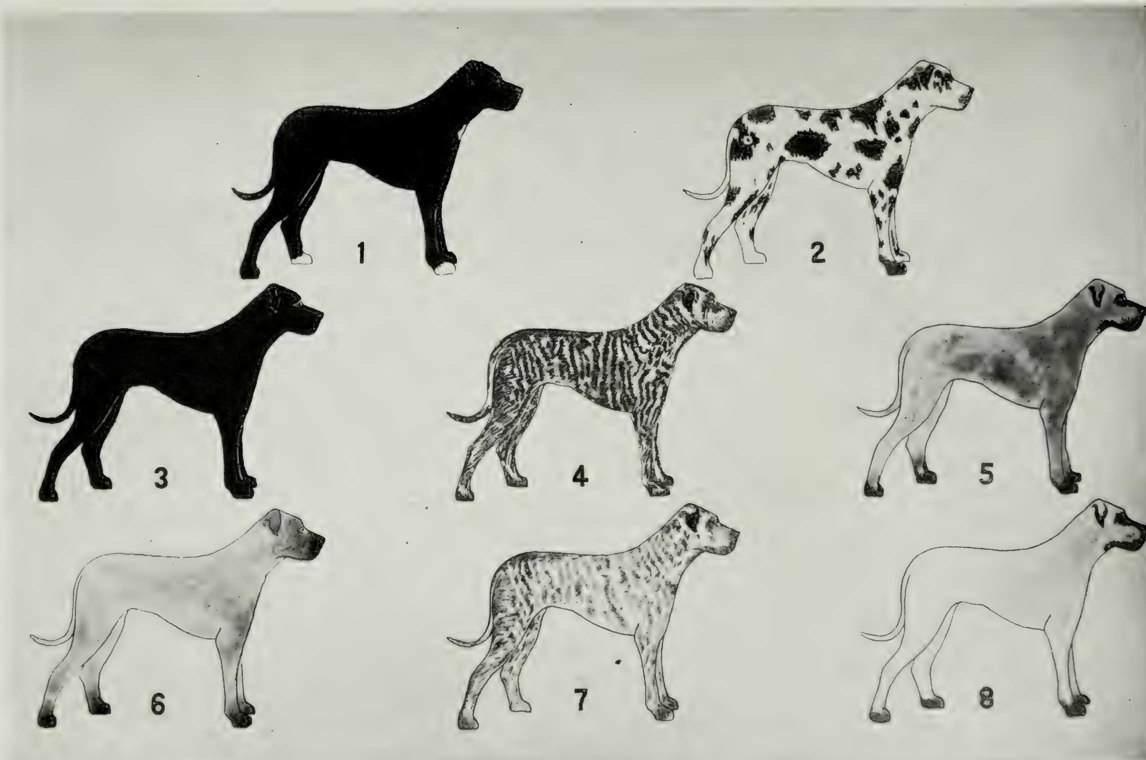
Brindles vary considerably in depth of color. They may have a rich, golden ground color or a duller and darker brown. The pattern which appears on this ground color is an irregular streaking with black. It is variously described as brindled, streaked, striped, or tigered. The relative amount of black and yellowish-brown pigment in the coat varies considerably, some brindles being almost entirely fawn with a trace of black, and others being predominantly, if not entirely, black, in appearance. Some evidence that brindles may rarely be entirely black in appearance or, at the other extreme, fawn, will be presented when the detailed color crosses are considered.

Dilute brindles have a dull, silvery type of coloration affecting both the ground pigment and the dark striping and giving an appearance easily distinguishable from the light but intensely pigmented brindles. The difference is qualitatively almost exactly that recognized in other mammals and described by one of the writers in the case of yellow mice (Little, 1911).

Spotted forms are of two sorts, harlequins already described, and dogs on which small white spots occur on the chests or feet. (Fig. 12, No. 1.) Harlequin is a pattern producing, on the one hand, a pure white animal with a dark nose, and on the other hand an animal with a very small amount of white. Individuals of the latter sort might possibly be confused with animals possessing spotting of the second (non-harlequin) type. Animals with the second type of spotting are not considered desirable specimens, and are in Great Danes, as in other breeds, vigorously selected against. The effects of this upon their occurrence and description will be considered later.

(*c*) *Review of Previous Literature.*—One of the writers (Little 1914) has used the American Kennel Club Stud Books for the purposes of studying color inheritance in pointers and has reportep the existence of certain alternative color types referable to Mendelizing factors. One of these, the factor for black pigment, the hypostatic form of which produces brown pigment, had been observed previously by Lang, 1910, in a single cross which he made. This mutation from large B to small b does not appear to have occurred in Great Danes in so far as the records studied are concerned. One dog was described as "liver" in color, but inasmuch as blue commonly approaches "liver" in appearance and, further, inasmuch as this dog occurred in a mating where blues would be expected, the dog in question has been classed as blue. The second factor to be recognized in pointers is the factor E for the extension of black and brown pigment in the coat. In the hypostatic form of this factor the colored portions of the coat are orange or lemon-yellow. Whether the yellow of pointers is identical with, or comparable to, the fawn type of Great Danes is doubtful. It represents a distinctly yellow type in which there is no marked darkening of the muzzle or the extremities such as one finds in fawn Great Danes. Until further careful experimentation is made, therefore, we shall have to recognize four distinct and possibly genetically different types of red-yellow coat pigmentation in dogs: First, the orange or lemon-yellow of pointers and English setters; second, the brownish-yellow of most "red" dachsunds, and possibly of Irish terriers; third, the dark, muzzled fawn of bulldogs, greyhounds, and Great Danes; and finally, the almost mahogany red of Irish setters. The genetic relationships of these four types would make a most interesting study.

In 1915, Barrows and Phillips found that the B and E factors were both present in cocker spaniels, and in addition discovered indications of a dilution factor producing dilute black or blue individuals and also, in the yellow series, cream or white. On page 393 they state that dilute reds are cream in color. Whether, however, dilute reds might not also be dull



COLOR VARIETIES IN THE GREAT DANE

In this breed of dogs several color varieties are distinct and well established. "To reduce these color varieties to a simpler basis from a genetic point of view they may be listed as follows: Black (No. 3 above), blue (dilute black, No. 6), harlequin (black and white, No. 2), brindle—various shades including a dilute or 'blue' brindle (No. 7), fawn—various shades including a dilute light, or 'dove' fawn (No. 8). (Fig. 12.)

faded yellow in color does not appear to have been considered. From analogy with all the forms previously worked on, in which a dilution factor of the type apparently existing in cocker spaniels has been established, one would expect that such would be the case. What we believe to be conclusive evidence of a dilution factor in Great Danes will be considered later.

The evidence on the inheritance of spotting obtained by Barrows and Phillips is extremely interesting, for it apparently demonstrates that there are at least two types of spotting. Thus spotted by spotted matings produced two hundred and twenty spotted and fourteen solid colored individuals. The spotted parents in these cases were apparently the ordinary parti-colored cockers in which considerable white is always present. When solid pigmented animals were crossed together, nineteen solid colored individuals were produced, and in addition two pups from a single litter showed very small white spots on the breasts. We shall see later that these conditions are paralleled closely in Great Danes.

Wright, 1918, in reviewing color inheritance in mammals, recognizes in dogs the existence of the B and E factors and of the dominant spotting which he calls R, or roan. Just how far this roan factor is similar to the fine mixtures of pigment found in the roans of horses and cattle is uncertain. It seems quite possible that in short-haired dogs such as Great Danes or coach-dogs, a type of color distribution which in the long-haired breeds such as English setters produces a mixture of indistinct spots and regions of apparent "roaning," might produce clear, well-defined spots. The possible danger of considering the dominant spotting found in cocker spaniels a true roan is seen in such varieties of dogs as the "tigered" or "dappled" dachsund. Here there appears to be a real intermixture of black, sparsely pigmented, and almost, if not entirely unpigmented hairs; a condition which more closely resembles the roans which have hitherto been described. Wright further recognizes a probable factor for piebald spotting which he considers at the present time unanalyzed. He also mentions the interesting experiments of Pearson, Nettleship, and Usher, resulting in the isolation of a factor for partial albinism in Pekinese. With this brief review we may now turn to a consideration of the observed facts.

II. OBSERVED EXPERIMENTAL RESULTS

The following matings have been recorded from data derived from the American Kennel Club Stud Books, Volumes 11 to 34 inclusive. As was the case in pointers, numbers before Volume 11 represented data collected at a time and under circumstances not well adapted to accuracy, and contained only a small number of available animals. The strong and weak points in data collected from stud books have already been touched upon in an earlier paper by one of us already referred to (Little, 1914), and need not be further considered at present.

Inasmuch as many types of matings have been involved, it will be convenient to analyze them in groups according to the particular factor or factors which we believe they possess.

III. THEORETICAL INTERPRETATION

A breed of dogs such as Great Danes may biologically be considered as a mixed population. In so far as any one pair of allelomorphs are concerned there will be individuals of three sorts: DD, DR, and RR. If there has been no particular degree of inbreeding or selection, they will probably be present in approximately the proportion of one DD, to two DR, to one RR. Considering for a moment only the D individuals we find that in proportion to the degree of inbreeding and selection, the relative number of DD individuals becomes greater, and we might therefore expect some populations to show among their D animals a ratio of one DD to one DR, or perhaps two DD to one DR.

For a population in which DD and DR animals are present in these different proportions, characteristic ratios of D to R individuals will be formed as the

		Black + white (harlequin)	Brindle + white	Dil-Brindle + white	Dil.-Black + white	Black	Dil.-Black	Brindle	Dilute brindle	Fawn	Dil.-fawn	White	Total
A	Harlequin (B & W) x Harlequin (B & W)	188	6		6	25	10	14	2			4	255
B	Brindle x Brindle	1	2	9	1	4	2	420	12	60	5		516
C	Fawn x Fawn							2		37	4		43
D	Dil-Blk x Dil-Blk			4			40						44
E	Brindle x Brindle & Wht		2					16	1	2			21
F	Fawn x Fawn & Wht									2			2
G	Blk. x Harlequin (B & W)	7				9	1	2					19
H	Blk. x Dil.-Blk					3	2						5
I	Fawn x Dil.-Fawn									14	2		16
J	Brindle x Dil.-Brindle							23	8	6			37
K	Brindle x Harlequin	4				3		2		2			11
L	Brindle x Black	1				9	1	7		4			22
M	Brindle x Dil.-Blk. & Wht	1						1	1				3
N	Brindle x Fawn		1				1	251	5	166	9		433
O	Brindle x Dil.-Blk	3	5			1	4	10	2	5	2		32
P	Fawn x Black					1		2		1			4
Q	Fawn x Harlequin	2								2			4
R	Fawn x Dil.-Blk					1	4	6	1	1			13
S	Blk. x Dil.-Blk. & Wht					1		2		2			5
T	Harlequin x Dil.-Blk	3					2						5
U	Harlequin x Brindle & Wht	5					1						6
V	Harlequin x Dil.-Brindle	1						1	3	2			7
W	Blk. x Dil.-Brindle					2		3	2	1			8
X	Fawn x Dil.-Brindle							6	5	2			13
Y	Brindle x Dil.-Fawn							17		6	1		24
Z	Brindle & Wht. x Dil.-Fawn							1					1
A[1]	Brindle & Wht. x Fawn							1		1			2
B[1]	Harlequin x Dil.-Blk	1					1	1					3
C[1]	Dil.-Brind. x Dil.-Fawn								5				5
D[1]	Harlequin x Dil.-Fawn							1					1
E[1]	Dil.-Fawn x Dil.-Blk			1			1		2				4
F[1]	Fawn x Dil.-Blk. & Wht		2	3				2					7
G[1]	Harlequin x White	1							1				2
H[1]	Brindle x White							5		2			7
I[1]	Dil.-Fawn x Fawn & Wht							2		1			3
	Total	218	18	17	7	59	70	798	50	319	23	4	1583

result of random matings of D individuals *inter se* as follows:

D animals crossed *inter se*

Ratio of animals in population	Ratio of DD or DR animals to RR in progeny of random matings
(a) 1 DD : 2 DR......	8 : 1
(b) 1 DD : 1 DR......	15 : 1
(c) 2 DD : 1 DR......	35 : 1

Similarly the incidence of DD and DR types in a relatively fixed proportion in any population will result in definite ratios from the back cross of D with R individuals. Any population which, in respect to a given pair of factors, gives, when D animals are crossed *inter se*, a ratio of type (*a*), (*b*), or (*c*), should approach the corresponding ratio in back crosses of D animals with R as follows:

D animals crossed with R

Ratio of animals in population	Ratio of DD or DR animals to RR in the progeny of random matings
(a) 1 DD : 2 DR......	2 : 1
(b) 1 DD : 1 DR......	3 : 1
(c) 2 DD : 1 DR......	5 : 1

(*a*) *The factor D for intensity; d for dilution*

Matings involving these two color phases are tabulated in Tables II, III, and IV. In each case the mating designations refer to Table I.

It will be seen from Table II that the ratio of intense to dilute animals is approximately 15 : 1. We have, in the bottom three lines of the table, data which will serve to test how closely the observed figures conform with the expected numbers under an 8 : 1 and a 15 : 1 ratio. Figures for a 35 : 1 ratio are not, in this case, given because of the fact that it is obvious that the observed numbers are in closer agreement with a 15 : 1 ratio than they would be with a higher ratio.

TABLE II

Matings D and D

Mating	D Intense	d Dilute
A....................	233	18
B....................	487	29
C....................	39	4
E....................	20	1
F....................	2	..
G....................	18	1
K....................	11	..
L....................	21	1
N....................	418	15
P....................	4	..
O....................	4	..
U....................	5	1
A¹....................	2	..
Total (a)...............	1264	70 ± 5.49
Expected 15 : 1 (b).......	1250	83 ± 5.94
Expected 8 : 1 (c)........	1185	148 ± 7.83
Difference (a) and (b)	....	13 ± 7.96
Difference (a) and (c)	....	78 ± 9.56

The probable errors calculated in each case on the smaller phenotypic class show that between the observed numbers and the 15 : 1 ratio, there is a difference of 21 ± 7.5. The difference, which is 2.7 times the probable error, makes it not unlikely that the observed figures represent a chance deviation from this ratio. On the other hand, the difference between the observed figures and an 8 : 1 ratio is 86 ± 9.5. In this case the difference is 9.0 times its probable error, and the odds are practically certain that the observed figures depart significantly from an 8 : 1 ratio. This being the case, Table III, which records the cross of intense animals with dilute, should show a closer approximation to a ratio of three intense to one dilute than to a 2 : 1 ratio. This proves to be the case, although the numbers are so small that the difference between the observed figures and the 2 : 1 ratio cannot be considered as certainly eliminating the possibility that a 2 : 1 ratio is involved. However, inasmuch as the difference between the observed figures and the 3 : 1 ratio are less than the probable error, it seems extremely likely that the 3 : 1 ratio is the actual one involved.

TABLE III

Matings D and d

Mating	D	d
H	3	2
I	14	2
J	29	8
M	2	1
O	24	8
R	8	5
S	5	...
T	3	2
V	4	3
W	6	2
X	8	5
Y	23	1
Z	1	
B¹	2	1
D-	1	...
F¹	4	3
I¹	3	...

(a) Total.............. 140 43 ± 3.8
(b) Expected on 3 : 1 ratio 137–46 ± 3.9
(c) Expected on 2 : 1 ratio 122–61 ± 4.3
Difference (a) and (b) 3 ± 5.4
Difference (a) and (c) 18 ± 5.7

Table IV shows the results of mating dilute animals *inter se.* While the numbers are small the results are consistent with the supposition that dilute forms are hypostatic to intense and all fifty-three animals obtained are dilute pigmented.

TABLE IV

Matings D and d

Mating	D	d
D	....	44
C¹	....	5
E¹	....	4
Total	....	53

(*b*) *The factors E for full extension, E^1 for partial extension, and e^1 for restriction of black pigment*

In the mixed population of Great Danes under consideration, the ratio of E, E^1, and e^1 types obtained when E forms are crossed *inter se* or with e^1 will be characteristically distinct and will give some idea as to the degree of inbreeding and selection involved. Thus:

Crossing E animals *inter se.*

Ratio of E types within a mixed population	Ratio of E to E^1 to e^1 animals obtained by random matings
(*a*) 1EE : $1EE^1$: $1Ee^1$	32 E : $3E^1$: $1e^1$
(*b*) 2EE : $1EE^1$: $1Ee^1$	60 E : $3E^1$: $1e^1$
(*c*) 2EE : $2EE^1$: $1Ee^1$	75 E : $8E^1$: $1e^1$

Crosses of E x E^1

Ratio of E types within a mixed population	Ratio of E to E^1 to e^1 animals obtained by random matings
(*a*) 1EE : $1EE^1$: $1Ee^1$	4E : $1E^1$: $1e^1$
(*b*) 2EE : $1EE^1$: $1Ee^1$	6E : $1E^1$: $1e^1$
(*c*) 2EE : $2EE^1$: $1Ee^1$	7E : $2E^1$: $1e^1$

Table V shows a combination of all matings involving the factor E. If the E x E matings be first considered, it will be noted that the ratio of 309E to $22E^1$ to $2e^1$ approximates very closely the numbers expected on a 75 to 8 to 1 distribution. Referring to the list of matings given above, it will be seen that the 75 : 8 : 1 ratio depends upon the supposition that EE and EE^1 individuals occur with equal frequency in a mixed population and which are each of them twice as numerous as Ee^1 animals. This is not at all unlikely, for blacks or harlequins (E) and brindles (E^1) are about equally popular in Great Dane breeding, and both of them appear far more frequently than do fawns (e^1).

TABLE V

Matings of EE^1 and e^1

Cross E×E

Mating	E	E^1	e^1
A	235	16	....
D	44	....	....
G	17	3	....
H	5	....	....
S	1	2	2
T	5	....	....
D¹	2	1	....
Total	309	22	2
75 : 8 : 1 ratio	300	32	4

Cross E × e^1

Mating	E	E^1	e^1
P	1	2	1
Q	2	....	2
R	5	7	1
D^1	....	1	....
E^1	2	2	....
F^1	3	4	....
Totals	13	16	4
7 : 2 : 1 ratio	22.4	6.4	3.2

Cross e^1 × e^1

Mating	E	E^1	e^1
C	....	2	41
F	....	....	2
I	....	....	16
I^1	....	2	1
Totals	....	4	60

Cross E×E^1

Mating	E	E^1	e^1
K	7	2	2
L	11	7	4
M	1	2	....
O	8	17	7
U	6	....	....
V	1	4	2
W	2	5	1
Totals	36	37	16

Cross E^1×e^1

Mating	E	E^1	e^1
N	1	257	174
X	....	11	2
Y	....	17	7
Z	....	1	1
A^1	....	1	1
C^1	....	5	....
Totals	1	292	185±7.18
2:1 ratio	....	318	159±6.94
Difference	....	....	26±9.9

Cross E^1×E^1

Mating	E	E^1	e^1
B	9	442	65
E	....	19	2
J	....	31	6
Totals	9	492	73±5.38
8:1 ratio	....	510	64±5.08
Difference	....	....	9±7.4

If a triple allelomorph series is involved between the factors E, E^1, and e^1, the only types of matings which should give all three phenotypes are E x E, E x e^1, and E x E^1. Such, however, is not actually the case. We find, for example, that there are nine E animals obtained in matings of E^1 x E^1 individuals in a total of 574 offspring. Similarly, there is one E individual in matings of E^1 x e^1 in a total of 477 offspring; and finally, there are four E^1 individuals in a total of sixty-four progeny produced by e^1 x e^1 matings. Some, or perhaps all of these exceptions might be explained by errors in recording parents or in the stud books. There appears, however, to be another possible explanation which should receive consideration.

If one examines a large number of specimens of brindle Great Danes, he finds that they vary greatly in the amount of black pigment which they possess. Some of them are so nearly fawn as to have only a small spot of dark hairs, while others are almost indistinguishable from blacks. This is a common condition in all brindle and similar patterns. It is found in yellow mice, tabby cats, and in agouti rabbits, mice, and guinea-pigs. That it is a recognized trouble maker in breeding brindle Great Danes is shown by the following quotation from Leighton (*loc. cit.*): "When brindle Great Danes have been continuously bred together it has been found that they get darker and

that the peculiar striping disappears, and in that case the introduction of a good fawn into the strain is advisable."

It seems therefore entirely probable that at least a part of the nine blacks (E) appearing in the $E^1 \times E^1$ matings and the one black appearing in the $E^1 \times e^1$ matings represent brindles of this extremely dark or blackened type, while the four brindles (E^1) which appear in matings of fawn x fawn may well be due to the fact that one of their parents was an extremely light brindle in which the black was so reduced that it appeared phenotypically like a fawn and was so recorded. The occurrence of exceptions of this type is therefore expected, provided that the brindle pattern of Great Danes behaves as all other similar pattern factors hitherto studied in mammals.

(*c*) *Factor H for harlequin spotting, h for absence of harlequin spotting or self coat.*

Inheritance of any form of spotting is complicated because of great variability in the degree of spotting, and of incompleteness of dominance in many cases, also because genetically different types of spotting all show themselves as simple contrasts between colored and white areas. Even with all these handicaps, however, the data obtained from the A. K. C. stud books indicate that there are at least two genetically different types of spotting in Great Danes. We may first consider the more striking of these, namely harlequin spottings. (Plate 1, Fig. 2.)

Animals of this type when crossed together have given, in addition to harlequin, a considerable number of self animals as shown in Table VI. From a fancier's point of view, harlequins by inbreeding continually tend to grow too light, that is, to have too little black pigment. The method followed to correct this is to cross harlequin with self intense blacks. (Fig. 12, number 3.) This leads to an increase in black areas on the resulting harlequins.

TABLE VI

Matings H×H

Mating	H	h	
A	188	63	
Totals	188	63	±4.63
Expected 3 : 1 ratio	188	63	±4.63
Expected 8 : 1 ratio	221	31	±3.57
Expected 15 : 1 ratio	235	16	±2.61

Matings H×h

Mating	H	h	
G	7	12	
K	4	7	
Q	2	2	
V	1	6	
B^1	1	2	
D^1		1	
Totals (a)	15	30	±2.13
Expected (a) 1 : 1 ratio	22	22	±2.26
Expected (b) 2 : 1 ratio	30	15	±2.13
Expected (d) 3 : 1 ratio	34	11	±1.94
Difference (a)×(b)	7±	3.1	$\frac{\text{Diff.}}{\text{P. E. Diff.}}=2.2$
Difference (a) and (c)	15±	3.0	$\frac{\text{Diff.}}{\text{P. E. of Diff.}}=5.0$
Difference (a) and (d)	19±	2.89	$\frac{\text{Diff.}}{\text{P. E. of Diff.}}=6.5$

Matings h×h

Mating	H	h
B	1	515
C		43
D		44
H		5
I		16
J		37
L	1	21
N		433
O	3	29
P		4
R		13
W		8
X		13
Y		24
C^1		5
E^1		4
Totals	5	1214

Because of the generality of this practice one might expect that the great majority of harlequins would be heterozygous and that the result of crossing two harlequins would be to approximate a ratio of three harlequins to one self colored. This as can be seen from Table VI is exactly the result obtained, and we may therefore consider that it is extremely probable that harlequin represents a form of spotting depending upon a factor epistatic to self colored. Furthermore, when harlequins are crossed with self blacks, the small number of young obtained show a ratio which is not significantly different from a one to one ratio. This supports the view that the harlequins used for breeding are commonly heterozygous. The matings of animals lacking the harlequin spotting factor are last to be considered. These have given a total of 1,219 offspring. Of these, five, or less than four-tenths of one per cent, are harlequin, and the remainder are self as expected. It is extremely likely that these five exceptions are due to stud-book errors, for they occur so rarely that it is hard to believe that they are genetically significant.

The harlequin spotting factor appears to be not unlike the dominant spotting observed by Barrows and Phillips in cocker spaniels, although, of course, the actual distribution of the spots differs in the two forms, those of the Great Danes being far more irregular in outline.

(d) *The Factor S for Self Color, and s for "piebald" spotting*

The term "piebald spotting" is perhaps a misnomer, for apparently the only manifestation of this type of spotting which exists in Great Danes is the occasional occurrence of animals with a white chest spot or with white feet, or with both. Such an animal is shown in Fig. 12, No.1. Such forms are not desired and are rigorously selected against by fanciers. Inasmuch, however, as their appearance depends upon an hypostatic factor, the entire elimination from any strain has proved to be difficult, and they still crop out at rare intervals. That they appear less frequently than animals possessing the other hypostatic factors already considered is shown by Table VII. Here matings of self x self animals have given 1,214 offspring, of which

Table VIII

Matings S × S			Matings S × s			
Mating	S	s	Mating	S	s	
B	503	12	E	19	2	
C	43	......	F	2	......	
D	40	4	M	2	......	
H	5	......	S	5	......	
I	16	......	Z	1	......	
J	37	......	A¹	2	......	
L	21	......	F¹	2	5	
N	432	......	I¹	3	...	
O	24	5	Total	36	7	±1.63
P	4	......	Expected 2 : 1	29	14	±2.7
R	13	......	Expected 3 : 1	32	11	±1.93
W	8	......	Expected 5 : 1	36	7	±1.63
X	13	......				
Y	25	......				
C¹	5	......				
E¹	3	1				
Total (a)	1192	22	±3.14			
Expected : 1 (b)	1079	135	±7.38 Difference (a) and (c) 54±6.5			
Expected 15 : 1 (c)	1138	76	±5.69 Difference (a) and (d) 12±4.9			
Expected 35 : 1 (d)	1180	34	±3.87			

twenty-two are spotted. At the bottom of the table, a comparison between the observed figures and the numbers expected on 8 : 1, 15 : 1, and 35 : 1 ratios is made. It will be noted that the 35 : 1 ratio is most closely approximated and that this ratio probably means that there are two SS to one Ss individuals in a mixed population of self Great Danes.

Confirmatory evidence is obtained from the matings of self with spotted animals, also shown in Table VII. Here, a 5 : 1 ratio is expected if two out of each three self animals are SS in formula. So far as the numbers obtained are concerned, this expectation is exactly fulfilled, although the numbers are so small that without the additional evidence from the cross of self animals *inter se* it could not properly be considered as definitely proving the point in question.

(e) List of factors known to date in dogs

It may be useful at this point to make a list of color factors recognized in dogs, in order that their relations may be considered and that future experiments may be planned with them in view. They are as follows:

(1) C, the color factor, modification of which, c^1, produces partial albinism; (2) B, factor for black pigmentation, modification of which, b, produces brown or chocolate coat color, (3) E for extension of black and brown pigmentation, modification of which, e, produces orange or lemon-yellow coat color. It is possible that the black and tan pattern and the brindle and fawn coat patterns may fall into this series. The two latter are therefore, for the present, classed as follows: E^1 modification of E producing brindled coat pattern such as is found in Great Danes, bulldogs, Boston terriers, and greyhounds. e^1 modification hypostatic to E^1 producing fawn coat color ound in Great Danes, greyhounds, bulldogs, and Boston terriers. Further experimentation may serve to show that E^1 and e^1 are in reality not modifications of E but are genetically in a different allelomorphic series. One might, at present, if he so desired, class them as members of a separate series, until their relationship with the yellow of pointers and English setters is definitely established. We have, however, chosen to consider them as modifications of E until they are proven to be independent. (4) D factor for intensity of coat color, modification of which, d, produces dilute pigmentation of black, brown, or yellow coat color. This factor is distinct from the albino series and is comparable to the similarly designated factor described by Castle and Little (1909) in mice, or to the maltese dilution of cats described by Doncaster (1905), and confirmed by Whiting (1918), or to the dilution factor described by Castle and others (1909) in rabbits. (5) H factor for irregular white spotting (harlequin spotting)—many irregular colored spots on a white ground. The spotting is apparently independent of regional distribution on the body and is characteristic of harlequin Great Danes, but also possibly found in cocker spaniels and English setters. h modification of this factor producing, in the absence of any other factors for spotting, a coat without any white spotting. (6) S factor for self or solid coat color, a hypostatic modification of which, s, produces animals with a small amount of white, possibly confined to a chest spot or single foot spot. Quite probably from a mixed population such ss animals might be selected to form a race of true piebald animals with a considerable amount of white in the coat.

In addition to the above, several color phases occur which are undoubtedly referable to mendelizing factors. These may be listed as follows: (1) Black and tan coat pattern, apparently recessive to solid coat pattern. (2) Dominant yellow such as occurs in dachshunds. (3) R, a roaning pattern. This factor is seen in so-called "tigered" dachshunds and possibly in Blue Merle collies. It is in all probability dominant to solid coat and independent of the other factors listed above.

(f) The Value of Dogs as Genetic Material

Recent investigations of Malone (1918) have shown that there are in dogs two classes of sperm, bearing

eleven and ten chromosomes respectively. This being the case, it seems probable that dogs represent, even in spite of their slow breeding and large size, the best material available among the mammals for a relatively complete genetic analysis. They are found in more color varieties than occur in any other domesticated animals. They have more structural differences and a greater size difference between breeds as well as a greater difference in number of young per litter than are found in other mammals. There is apparently complete fertility between different breeds. Artificial insemination has been tried (Iwanoff, 1903) and has been found possible, a fact which might enable experimenters to overcome any mechanical difficulties in crossing very large with very small breeds. They possess more clearly defined instincts, characterizing various varieties than do other mammals. To sum up, therefore, it may be stated that if an investigator is willing to wait for his results, dogs provide a field unequalled among mammals in the respects above outlined.

IV. SUMMARY AND CONCLUSIONS

From a study of the breeding records of Great Danes in the American Kennel Club Stud Books, the following conclusions can be drawn:

1. There is a single mendelizing factorial difference between the intense pigmented (black, brindle, and fawn) varieties on the one hand, and the dilute varieties (dilute black, dilute brindle, and dilute fawn) on the other hand. The factor D for intensity is epistatic to its allelomorph d—the factor for dilution.

2. The three coat conditions represented by solid black, brindle, and fawn are dependent upon three mutually allelomorphic factors: E for full extension of black pigment, E^1 for its partial extension as seen in the brindling pattern, and e^1 for its restriction to the muzzle, nose, feet, and a small area near the eyes—a condition typical of the fawns. Black (E) animals may carry either brindle (E^1) or fawn (e^1) but not both; brindles (E^1) may carry fawn (e^1) but not black (E), and fawns (e^1) can carry neither brindle (E^1) nor black (E).

3. Harlequin spotting (H) is epistatic to solid coat color (h) and apparently differs from it by a single mendelizing factor.

4. Minute white spots on the chest or on the feet occur rarely among the progeny of solid colored animals. Their appearance is probably due to a factor (s) for piebald spotting which is hypostatic to its allelomorph (S) for self coat color.

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OLNEYA BEANS

A Native Food Product of the Arizona Desert, Worthy of Domestication

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So many different trees are called ironwood in other parts of the United States that further use of this name for *Olneya tesota* should be avoided. As the tree is confined to the southwestern deserts, names like "desert ironwood," "southwestern ironwood," or "Sonora ironwood," the last proposed in Britton's "Trees of North America," might serve, but such compounds are too awkward and tedious in repetition to be used consistently. The Mexican name, *palo fierro* or *arbol de hierro*, meaning *iron tree*, may come into use, since *palo verde*, meaning *green tree*, has been adopted generally in the southwest for another leguminous tree (Cercidium), which is a regular companion of Olneya in the desert. But *palo fierro* and *arbol de hierro* are not more distinctive names in Spanish than ironwood in English, and are applied to trees of many kinds in Mexico and other parts of tropical America. Use of the generic name Olneya, or the name *tesota*, recorded by the Mexican boundary explorers and recognized in Gray's botanical designation of the species, would avoid the difficulties.

The only economic feature of Olneya noted in botanical works of reference is that the wood is very heavy, hard, and difficult to work, though sometimes used for special purposes and generally valued as fuel. Possibilities as an ornamental are suggested by Britton's reference to Olneya as "a most beautiful tree." The grayish foliage and gnarled trunks give a slight similarity to the olive, set off in May by an abundance of pinkish-purple blossoms, in form like those of the locust tree, to which Olneya is related. It is the largest as well as the most attractive tree that grows as a true native of the driest southwestern deserts, away from the stream beds and with full exposure to heat and drought.

A forage value is recognized in "New Trails in Mexico," by Lumholtz, who tells how the mules, donkeys and horses left good grass to feed on the leaves of palo fierro. "They stretched their necks like giraffes in eager competition and, paying no heed to its numerous thorns, they pulled away mouthfuls of leaves." This has to be corrected to the extent that Olneya has no true thorns like those of the mesquite, but as in the screw-bean there are slender spine-like stipules 4 or 5 mm. long on the upright shoots, though the smaller twigs are unarmed. Referring to a district in Sonora, between Santa Ana and Trincheras, Lumholtz also says: "For three or four hours we were crossing a large, low mesa with a predominant vegetation of palo fierro trees, the leaves of which furnish here the sole subsistence for herds of cattle. They grow fat on this, drinking water only every third day." The flowers also are said to be eaten as they fall to the ground, and to fatten the stock.

Thus we have Olneya as a handsome flowering tree, with a dark, heavy, hard wood like ebony, and with foliage and flowers that are eaten with avidity by animals and are nutritious, like alfalfa. To this reckoning must be added the fact that the Olneya trees bear thick crops of pods not unlike those of garden beans, and that each pod may have several seeds, unlike the small bony seeds of the mesquite, but of the size, appearance and texture of small peanuts and having the same agreeable flavor when roasted, so that they can be used as food. Young pods probably could be cooked and eaten like green beans, since the texture is fleshy and the taste not bitter, even in the raw state.

THE OLNEYA TREE

Above, the largest Olneya tree in the vicinity of Sacaton, Arizona, about 30 feet high and 2 feet in diameter. Below, an Olneya tree cut off near the ground, with a new crown of upright sprouts, bearing a large crop of beans. (Fig. 13.)

though somewhat astringent. The pods are not limited to one or two seeds, as the works of Gray and other botanists would indicate, nor is the tree of very slow growth as commonly supposed, from its behavior under extreme desert conditions. In short, Olneya is a tree that may be found worthy of cultivation, in spite of the fact that it is not planted or even allowed to survive around any of the southwestern settlements.

It seems remarkable that the production of edible beans by Olneya was not the first fact to be recorded, or at least one of the first to attract attention, but this feature of the tree has remained practically unknown, even among those who have lived long in the southwest. One reason may be that the beans ripen about the first of August when even botanists and explorers avoid the hot deserts. Emory passed through the Gila Valley in November, 1846. Bigelow's specimens of Olneya were collected in northern Arizona in February, 1854, and are said by Torrey to be "in fruit only," no doubt the empty pods of the previous season. Bigelow states that the Mexicans who accompanied the Whipple Expedition, and who doubtless joined it in New Mexico, were not acquainted with the tree nor with the name *tesota*. It seems not impossible that the tree at first was confused with the mesquite or the "cat's claw" acacia, the latter also said to have been called *tesota*. The word *tezoatl* appears in Simeon's Aztec dictionary as the name of a shrub of the hot lands, the leaves of which are used to make a dye, while *texotia* or *texotli* is an Aztec word for a blue color. In the Pima language the tree is called *hait kam*, according to Russell.

The first Olneya beans that came to my attention in October, 1916, were in the hands of a venerable prospector living near the abandoned town of Picacho on the California side of the Colorado River, about 30 miles north of Yuma. A stock of the beans had been collected for eating and to make a beverage that was compared to chocolate. The old prospector's "native peanuts" were remembered in July, 1918, on seeing abundant crops of pods on many of the Olneya trees in the deserts around Sacaton, in south-central Arizona, and as the beans ripened many differences were noted, some of practical interest from the standpoint of cultivation.

No two trees seem to produce exactly the same kind of beans. Usually the difference between beans of neighboring trees were not merely appreciable, but obvious, and comparable to those that distinguish cultivated varieties in other genera of the pea family. Corresponding differences were noted in the pods and in the characters and behavior of seedlings of the same parent tree. Many writers assume that wild species normally are uniform, and that diversities among cultivated plants are induced by conditions of domestication or by hybridization. But Olneya is a monotypic genus, and individual diversity or heterism, instead of uniformity, appears as the normal condition among the wild trees growing in their native deserts.

Though only one bean in a pod is the rule on some trees, it usually is possible to find some pods with at least two or three beans. Many trees have pods with several seeds, and some are distinctly large-podded, to the extent of nearly 13 cm. in length and 10 to 12 mm. in width, in the dry state. The largest pods had nine fully developed beans and two abortive, indicating that pods with eleven beans or more are sometimes produced. The number of seeds is a practical consideration, since gathering beans from trees with only single-seeded or two-seeded pods is much more difficult than from those that have pods with several beans. The color of the young pods is a light yellowish or brownish-green, sometimes mottled with red, as the pods of the Arizona mesquite often are. The color darkens to light coffee brown as the pods dry and shrivel.

Other differences between individual trees are in the proportioning of the pods to the beans. If the pods are ample so that there is no crowding, the

A NEGLECTED AMERICAN FOOD PLANT

"In view of the several possibilities of use it may seem strange that Olneya has not been cultivated before or that it was not domesticated by the native agricultural tribes of the southwestern States or of Mexico, but tree-crops were not a general feature of the native American agriculture." This photograph shows a branch of Olneya with nearly mature pods, from a tree that produces only one or two beans in a pod, as stated in botanical descriptions of the species. (Fig. 14, natural size.)

beans are regular in shape, but some trees have relatively shorter pods, so that the beans are crowded and flattened at one or both ends, and hence irregular in size and form, which would increase the difficulty of mechanical cleaning and sorting (Fig. 16). Some trees have relatively indehiscent pods that fall to the ground without shattering, while on other trees most of the pods open before falling, so that the individual beans have to be picked up, which takes much more time and labor.

Color also appeared as a practical consideration in collecting the beans, for those that were light-colored, grayish or brownish, were more difficult to find than the dark purple beans of other trees. The most difficult beans to pick up from the ground were light brown and finely speckled, these being hard to detect among the litter of coarse sand or gravel, fragments of dead wood, dry leaves, and pods under the trees. The colors range from a uniform light tan through various degrees of shading, mottling, and speckling with dull or pinkish purple to nearly uniform deep purple, nearly black in the mass.

From the standpoint of general desirability and ease of handling it seemed that the best trees to select would be those that bore abundant crops of long, many-seeded pods, not opening too readily, with large, plump, regularly formed beans, of the dark purple color. One such tree was found that seemed definitely superior to any other in combining the several requirements. Photographs of this tree were made, as well as of the pods and beans, and a part of the seed was planted at Sacaton, as Olneya No. 1 (see Figs. 13 and 17, No. 4). This tree had pods of the largest dimensions, as given above, with beans attaining 11 mm. in length, 9 mm. in breadth, and nearly 8 mm. in thickness. The surface of the beans is smooth and even, but under a lens shows very minute, close-set punctations. The hilum is white and rather prominent, and there is a small oval pit above the hilum, usually white and flat at the bottom, but sometimes reduced to a short, narrow groove. On the other side of the seed, diagonally across from the hilum, is a rather indistinct, broadly rounded prominence.

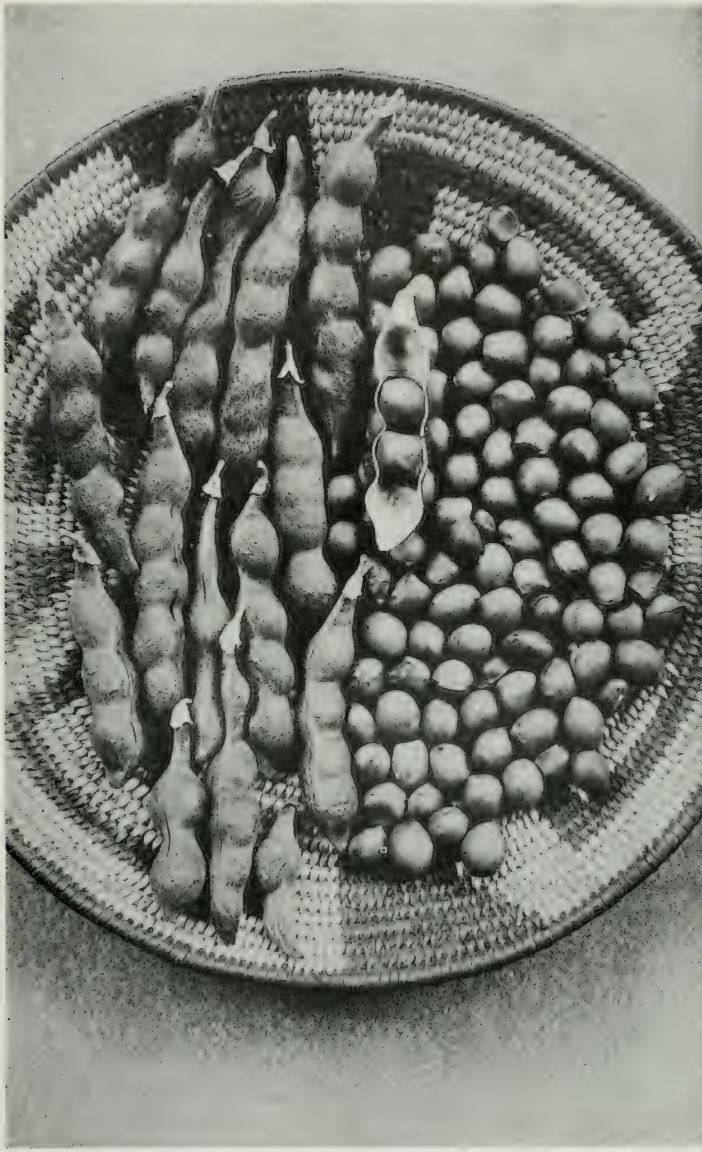
Still larger beans, with measurements of 12 mm. by 9.2 mm. by 7.2 mm., were obtained from another tree. These were of a nearly uniform light tan color, very finely speckled with purplish, and with much larger and less numerous punctations. Beans from several trees were weighed carefully by Mr. Harold F. Loomis. Averages of ten weighings of 50 seeds from samples representing seven individual trees were 13.617, 14.808, 14.231, 7.895, 12.682, 14.431, and 10.252 grams. The corresponding average weights of single beans of the seven trees are 0.272, 0.296, 0.285, 0.158, 0.254, 0.289, and 0.205 grams. The largest bean weighed 0.395 gram, with 0.357 gram as the average of 25 of the largest beans from the same tree, and 0.302 gram as the average of the sample from this tree, or nearly twice the average for the tree with the smallest beans. The largest beans are shown in Fig. 15, the smallest in Fig. 17, No. 2 and those of the tree considered most desirable in Fig. 17, No. 4. The tree with the largest beans bore only a small and late crop and had short pods, mostly with only one or two seeds, though a few had three or four (see Fig. 15).

The tree selected to furnish seed for planting was near the Pima village of Santan, north of the Gila River, opposite Sacaton. Two quarts of beans were collected from this tree. These were only a small part of the crop, but the others could not be gathered because of heavy rains that made the river impassable.

In the deserts around Sacaton only a few of the trees are large, most of them being sprouts from old stumps. Even the second growth is cut down as soon as a thickness of a few inches has been attained, although the yellow sapwood of the new growth is rather soft and is consumed rapidly by boring beetles. Cutting the older trees reduces the seed supply, and the second growth is browsed by cattle until the foliage is beyond reach. Browsing is worse, of

OLNEYA BEANS

Numerous variations occur in the size and character of the beans produced by Olneya trees. The ones here shown were the largest found in the vicinity of Sacaton, Arizona. (Fig. 15, natural size.)



BEANS AND DRY PODS

The dry pods of Olneya are firm in texture and not promptly dehiscent. The beans, which are somewhat crowded in the pods, are flattened at each end. (Fig. 16, natural size.)

course, in the vicinity of settlements, and the complete absence of tesota trees from the lower ground along the Gila River for several miles above and below Sacaton may be due to this cause rather than to susceptibility to frost. Like the giant cactus, Olneya does not come down to the river-bottom lands, but appears to be confined to the higher slopes, farther back toward the foot-hills. In both cases human activities and domestic animals may be important factors in reducing the chances of survival and of natural reproduction in the immediate neighborhood of the Indians.

Cattle may be responsible also for the extreme scarcity of young trees, which are seldom to be found in the Sacaton district, even well back in the desert. Although an abundance of small seedlings sprang up under many of the bearing trees after the August rains, they disappeared completely in a few weeks. No doubt the rabbits and other rodents, as well as the birds and insects, must always have taken a heavy toll of the young plants, but there must have been provision for this in the natural economy of the species. It may be that rabbits have become more destructive to the Olneya seedlings, since Pimas began to keep cattle about the middle of the last century.

Cattle are said not to range more than 3 or 4 miles from water, but the wood-cutters go farther into the desert, so that a general reduction of the seed crop from this cause also has to be recognized, and this again may help to explain why the Indians have ceased to gather the beans in recent decades. The range of wood-cutting depends, of course, upon the price, which often is very high. The use of Olneya wood for fuel has been very extensive, second only to that of mesquite, not only in Arizona but in the adjacent regions of Mexico. Railroads, mines, machine-shops and irrigation pumping plants have often used wood, in default of coal. Lumholtz explains that the easiest way to fell a tree is to make a fire at the base: "It ignites easily and burns the whole night through without any further attention."

It is apparent that only the extreme hardiness and tenacity of life of the old stumps and roots are responsible for the present representation of the species in many localities, and that when the vitality of these relics is finally exhausted a rapid extermination of the species must be expected, not merely from lands that can be brought under cultivation, but in the deserts where no other tree seems as well adapted to grow, except the useless *palo verde*. The possibility of retarding the destruction of the natural supplies or of propagating the species artificially might be worthy of consideration from the standpoint of fuel supply, even if there were no food or fodder possibilities to attract attention.

The possibility of making practical use of the natural supplies of the beans by gathering them from the wild trees in the desert is a question that might be raised in localities where the trees are still abundant, as they are said to be in some parts of the Papago country, in southern Arizona. There can be no doubt that the Indians used them formerly, though in recent years they seem to have been entirely neglected. One reason may be that needy Indians could get supplies of flour and other rations issued by the Government, and the increasing scarcity and remoteness of bearing trees undoubtedly would discourage any habit of relying on them for food. The fact that the bean harvest came at the period of the summer floods when the Indians were busy with their farms might also tend seriously to interfere with the gathering of the beans. The case is different with the mesquite, which has very hard, inedible seeds, and is spread by cattle and horses that eat the sweetish pods, which the Indians also grind and bake into loaves like bread.

If a systematic effort or test of the possibility of gathering tesota beans from the wild trees were to be made, no doubt the first step would be to cut off the low limbs and clear away

VARIATION IN OLNEYA BEANS

Samples of Olneya beans from four different trees are here shown, to illustrate variation in size, shape, color and other features. Nos. 1, 2, 3, 4, top to bottom. (Fig. 17, natural size.)

the bushes and the brushwood that accumulate under most of the trees, so that wagon-sheets could be spread to catch the beans, which could be knocked off readily with poles, most of the trees being low.

Picking up beans from the coarse gravel and vegetable debris under the trees is rather slow work, about an hour being required to collect a pound. But if values were to be reckoned on the basis of shelled peanuts, which are often sold at 50 cents and upward per pound, even this most laborious method of gathering the beans might appear justified if bearing trees were readily accessible.

Another question that naturally suggests itself is whether profitable yields could be obtained by planting the trees in orchard form. At present there are no data bearing on this subject beyond the fact that some of the wild trees are very prolific, so that a yield of half a bushel of beans per tree seems not impossible. At this rate of production orchard planting of Olneya might prove remunerative, and it might be found that other crops could be raised on the same land, as in the subculture system used in the desert oases of North Africa and other parts of the world. Even if the beans were not harvested for human use, turkeys or pigs might keep them from being wasted. Stores of beans collected by the desert rodents are said to have been drawn upon largely in former times by the Indians.

How rapidly the trees would grow, and how soon they would begin to bear if planted under favorable conditions, have still to be learned, since there appear to be no records of such experiments. Small stunted trees with trunks only 3 or 4 inches in diameter sometimes produce beans. Sprouts from old stumps may begin bearing when only 1 or 2 inches thick.

A first planting of Olneya at Sacaton in August, 1918, was lost, all of the seedlings being eaten off close to the ground, probably by rabbits. A second planting early in September, with wire protection, grew rapidly, and many of the seedlings were over a foot high by the end of October. Unlike some members of the pea family that have seedlings with simple leaves, Olneya has only compound leaves above the cotyledons.

That rapid growth may continue if the trees receive a regular supply of water is indicated by the fact that many vigorous new shoots, 4 or 5 feet long and over half an inch in diameter, were produced in the season of 1918 on old trees watered from a new well in the desert near Sacaton. Trees in rapid growth and in full leaf produce few or no beans, while trees that bore the heaviest crops of beans had only a sparse development of leaves.

It appears that Olneya, like many other desert trees, is extremely deep-rooted, so that transplanting may prove difficult or impossible. In an effort to transplant an Olneya tree from the desert near Yuma, reported by Mr. R. E. Blair, no lateral roots were found near the surface, and for 7 or 8 feet the large taproot remained entirely unbranched. Such a habit of root growth would indicate little or no interference with surface crops, so that Olneya may prove well adapted for planting in or near cultivated lands and may serve very well for hedges or wind-breaks, as well as for holding terraces or barriers against erosion, which are often needed in agricultural development of sloping mesa or foot-hill lands of the southwest. Even on desert lands that are too broken for irrigation it might prove worth while to plant belts of Olneya across the washes, to hold back and spread the flood-waters. More moisture would be absorbed by the soil, and more vegetation could grow in addition to the forage than the Olneya itself would afford.

In view of the several possibilities of use it may seem strange that Olneya has not been cultivated before or that it was not domesticated by the native agricultural tribes of the southwestern states or of Mexico, but tree-crops were not a general feature of the native American agriculture. The most conspicuous exception was cacao, which

seems to have been grown rather extensively as a subculture under larger forest trees in tropical districts of Central America. Most of the tree products are perishable, and the time required for trees to come into bearing is another reason for their not being popular among primitive peoples, who seldom cultivate the same land continuously for more than a few seasons.

The Sweetest Leaf Known

Several years ago a report ran through the press, originating in Asuncion, Paraguay, to the effect that there was a plant which grew wild on the prairies there, by the name of "Kaá Hee," *Eupatorium rebaudianum* (correctly determined later as *Stevia rebaudiana*) which had a substance in it 180 times as sweet as sugar. This report startled the sugar cane and sugar beet growers all over the world, and their fears were not allayed until it was discovered that the sweet substance was a glycerine and not a true sugar. Only the tiniest leaf fragment at that time reached Washington, and all efforts to secure the seeds of this interesting composite have until recently failed, but several ounces of the dried leaves and a small amount of seed have been received by the Department of Agriculture, through the American consul, and they have aroused a keen interest in all who have tasted them. A fragment a quarter of an inch square is as intensely sweet as saccharine. There is today so much discussion among dietitians as to the effects upon the health of the excessive use of cane sugar that the whole question of gratifying our most unusual taste for sweets is one deserving serious consideration. This is, as Professor Blaringham, of the Pasteur Institute, remarks, the age of sugar, "La siecle de sucre," but whether the fashion for sweets will be outgrown is a question for the dietitians to struggle with. Professor Osterhout, of Harvard, has shown that sugar increases the electrical permeability of the protoplasmic membrane of the cell, but just what inference is to be drawn from the discovery is a question. Having possibly a bearing upon this same problem, the following fact recently called to attention is worthy of publication:

"In southern Nigeria, according to Mr. A. H. Kirby, Assistant Director of Agriculture at Ibadan, there is a fruit tree or shrub known as the "Agbayun" (*Synsepalum dulciferum*), the slightly sweetish fruits of which, when eaten, have the peculiar property of making the sourest-tasting substances such as limes, lemons, unripe fruits, or vinegar' which are eaten within twelve hours or so afterward, seem intensely sweet.

Here would appear to be two substances, both worthy of investigation from the modern standpoint of foods. Seeds of both of these plants have been imported by the Office of Foreign Seed and Plant Introduction,—U. S. Department of Agriculture.

RACIAL ORIGINS AND HONORS OF WAR

The Anglo-Saxon Element and the Heroes It Produced

FREDERICK ADAMS WOODS

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THE possession of an Anglo-Saxon surname is not a proof of Anglo-Saxon descent, but it is at least a strong indication of probability. There have been a good many instances of Jews changing their names, presumably with the idea of concealing their real racial origin; and since the outbreak of the war many citizens of German parentage have shown a similar tendency. The Irish, who form a very large proportion of the entire population in Boston and its vicinity, are, on the contrary, proud of their race, and are not at all prone to change their ancestral cognomens. Whatever the error may be in assuming the surname a criterion of race, it is not a large one.

On the return to New England of the 26th Division (Y. D. or Yankee Division) of the overseas army, a great parade was held in Boston, April 25. The *Boston Globe* of that date published the pictures and names of all the chief heroes of that division, divisional, brigade, and regimental leaders, and all receivers of distinguished service crosses—commissioned officers, noncommissioned officers, and privates—369 in all.

Of the noncommissioned officers and privates, 170 out of 236 bore Anglo-Saxon names. This is over 72%. Commissioned officers of Anglo-Saxon names who had received distinguished service crosses numbered 46 out of 63, or over 73%. Of the 51 divisional, brigade and regimental leaders, 40, or over 78%, bore Anglo-Saxon surnames.[1]

The proportion of Anglo-Saxon names in the entire division is probably not as great as 72%[2] and if this be true, we have in these figures some proof for the assertion, so often made, that the Anglo-Saxons, and particularly the Yankees and the Canadians, who resemble them in race, and the Scotch, who carry a large proportion of Anglo-Saxon names, are particularly heroic and make fine soldiers.[3]

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[1] Anglo-Saxon: Arnold, Ashworth, Baker, Bamford, Bearrs, Bishop, Bulkeley, Bunnell, Chase, Cheatham, Cole, Dowell, Edwards, Foote, Gatchell, Glassford, Goodwin, Greenlaw, Greenway, Hale, Hays, Herbert, Hobbs, Howard, Hume, Isbell, Jones, Keville, Lock, Major, Parker, Petts, Sanborn, Shelton, Sherborne, Smith, Sweetser, Waterman, Whalmsley, Wheelock. Others: Aultman, Dolan, Durfee, Lassiter, Logan, Mack, McCaskey, Meyers, Murphy, Traub, Twachtman.

[2] This total proportion of Anglo-Saxon names in the entire 26th Division was probably not far from 50%. This is indicated by the fact that an examination of a long list of names, about a thousand in all, including those who received citations, commendations, congratulations, etc., but who did not receive distinguished service crosses, gives about 55% Anglo-Saxon names. List published in *Boston Evening Transcript*, April 25, 1919.

[3] As a criterion in deciding doubtful cases, use was made of Bardsley, C. W., "A Dictionary of English and Welsh Surnames with Special American Instances." London, 1901.

A Dangerous Horse Situation

We can well liken the horse business to an ocean. At times come tides, at other times comes the ebb flow. Just now the tide is setting very strongly in one direction—that of getting out of the horse business. Due to the inability of horse prices to follow the large increases in prices of wheat, corn, pork, beef and mutton, many farmers have quit the horse business. Their mares have been for sale to the horse buyer, in many cases, and even though mares were held, breeding has been neglected. The ebb flow of the ocean is just upon us.

It takes a very strongly anchored person to stand against the flow of tide. It is also usually a rather thankless job to advise going against any popular or well-nigh universal practice or habit. But there is always a tomorrow to be considered.

To illustrate the way the draft horse business is going, a short review of the history of the last several years in Tazewell County, Illinois, can be cited. Tazewell County has earned the fame of having more purebred Percheron horses per square mile of area than any other county in America. Old Louis Napoleon made history for the county in early days, and the draft horse interests have always been very large in the county. To obtain an accurate opinion as to the decrease in breeding in Tazewell County, the Tazewell County Percheron Association a short time ago canvassed the men owning stallions for the years 1915, 1916, 1917 and 1918. Direct questions were asked of each stallion owner as to the number of mares bred per stallion during these years. Enough replies were obtained to furnish reliable estimates. In 1915 there were recorded 155 stallions for public service. The average number of mares bred per stallion was 65. Counting a 50 per cent colt crop, there should have been 5,036 colts of the 1916 crop. In 1916 the number of registered stallions decreased to 140 and the average number of mares per horse also decreased to 55. This would be 3,850 colts for 1917. In 1917, the stallions again dropped to 115 and mares per stallion to 45½. According to this only 2,616 colts could be expected in 1918. Last year, 1918, the stallions only numbered 88, and the owners reported an average of 41 mares per stallion. This year we can expect about 1,800 colts. From 1915 to 1918 the stallions decreased from 155 to 88. The number of colts decreased from 5,036 to 1,800, or almost 180 per cent. Here is food for thought. If one of the big draft horse counties cuts down its horse production in this manner, what is going to happen to the supply of horses for market three and four years from now?

A like decrease can be seen in the decrease in stallions registered in the entire state. In 1912 there were 9,677 purebred and grade stallions licensed to stand at public service. In 1918, there were 7,120, or a decrease of 36 per cent.

The result is already becoming apparent in Tazewell County. The other day, the secretary of the County Percheron Association was trying to find some real geldings to price to a buyer. In the course of his search, a considerable number of men were consulted. No one knew of any big sound geldings of market age. A buyer of express horses told the secretary, a short time ago, that he was finding it very hard to find any horses suitable for his trade. Last August, in response to an inquiry for grade mares to over 50 men in Tazewell County, only 29 mares for sale were located.

In the light of these figures and from recent history, it begins to appear that there will be practically no horses soon. When that happens what will we do for work stock? And we will need work horses three, five, ten years from now.—Chester G. Starr, *Farm Adviser of Tazewell County, Ill.*

A BOOK ON THE SEXUAL QUESTION

MEN in Europe have often tried to bolster up a claim of superiority for their sex by pointing out that the perpetuation of the nation depended on its army and that they, by their compulsory military service, recognized and fulfilled the supreme obligation.

"But," the women have answered, "it is we who bear these men that thus defend the fatherland." Therefore they have claimed at least the equality of their sex.

Dr. Edward Toulouse, in his system of eugenics, proposes to take them at their word.

Every able-bodied woman, at the age of thirty, will be conscripted "to work, near her own home, for a certain number of hours daily, in a workshop, office or military hospital, in order to make available for actual military service all the soldiers who are commonly drawn off for non-combatant operations.

"The mother with three children will be exempt from this obligation; she who has two will do only six months of service; the mother of one child will serve for a year, and the childless woman two years."

"In this way woman will be pushed toward maternity by a force with a different compulsion than that of taxation. Obliged to perform a service that is noble, beautiful, equitable, but in practice disagreeable, or to bear children she will be naturally led to seek maternity. And in doing this she will not fear putting herself into a position of inferiority, for from the social as from the military point of view, procreation is more useful than an auxiliary service in the army. Similarly the husbands will rather make their wives mothers than send them into military service for two years. This method of preventing depopulation will be efficacious; and it will be only justice to make it serve the military interests of the state, which are particularly endangered by race-suicide."

A thorough-going proposal, is it not? French men of science are famous for the relentless clarity with which they push their arguments to logical conclusions, and Dr. Toulouse, in his book on social hygiene,[1] does not balk at any intermediate obstacles.

To enable this increase in maternity, financial means of caring for the children must be provided; but as children are in the last analysis the sole wealth of the state, Dr. Toulouse sees no reason why the state should hesitate to invest its funds in such good interest-bearing securities. He would have the expense of the early care and education of all children borne by the state if the parents required it; making no distinction between those of legitimate and illegitimate parentage.

But quality as well as quantity is necessary in a population, as the author does not fail to recognize; and he devotes a good deal of thought to finding the optimum compromise between these two contradictory demands. He would have the marriage, or at least the parenthood, of two persons with the same inheritable defect prevented. In case only one of the parents is tainted, it would suffice that the other be warned of the fact, so that at least he or she would marry with open eyes. To aid in this work of restrictive eugenics, he would have a "eugenics registry" maintained by the state, where all families would be described.

In this connection occur the principal errors of fact in a remarkable book. The author's views on "racial poisons"

[1] La Question Sexuelle et La Femme, par Docteur Toulouse. Pp. 288, prix f. 3.50. Paris: Bibliotheque-Charpentier, 11, Rue de Grenelle, 1918. Dr. Toulouse is medical director of the Villejuif Insane Asylum and one of the best known of French psychiatrists.

and the effect of disease on the germ-plasm are not supported by any evidence and must be considered as highly exaggerated.[2]

But it would be a mistake to think that the book as a whole is marked by these exaggerations. There have been few published discussions of social hygiene that are so sane, temperate, and national. Dr. Toulouse examines the many questions—the single standard of morality, free love, divorce, the proper age for marriage, monogamy and polygamy, illegitimacy, abortion, the position of women in industry—without dogma or sentiment, and always with a view to determining what solution will be most eugenic. In many ways his discussion is in advance of the current social hygiene literature of the United States, for in discussing such a question as the single standard he does not limit himself to arguments based on the fear of venereal infection and illegitimate parentage, as is too often done, but inquires into the philosophical bases on which chastity may be justified.

On the whole, the work is stimulating by the ideas it puts forth rather than by its presentation of any mass of data; for these are largely lacking. But few recent works on eugenics will better repay reading than this little volume by Dr. Toulouse.

All-Northwest Egg-Laying Contest

The egg-laying contest is a testing place for the poultry breeders of the state, and is also a testing place for those poultry raisers who want to improve their flock production. The contest, just closed, has clearly demonstrated that high egg production can be had from birds irrespective of altitude or other climatic conditions. The birds in the Second All-Northwest Contest came from places varying widely in all climatic conditions, as well as in available feeds. The high hen in the contest was a Single Comb White Leghorn, Number 251, which was bred, and is now owned by D. Tancred, of Kent, Washington. This bird laid 311 eggs during a period of 365 days. It is also a noteworthy fact that these birds made their records while kept in flocks of 36. The usual number of birds in other contests are from five to ten birds. It is more credit to a breeder to have a high record in a large flock than in a small one.

During the past seven years the poultry raisers have become more interested in the egg-laying contests. Men who are doing good breeding work are anxious to have their birds tested in order that they may have official records of their production. Egg-laying contests have brought clearly before the poultry public that in order to have birds that would produce eggs, it would be necessary to have good breeding back of the birds. Feed is, to be sure, an important factor in egg production, but it is necessary to have birds which are able to handle feed and convert it into eggs before high records can be made either at home or at the contests. The poultrymen who enter their birds in the egg-laying contests, year after year, show a marked improvement in the quality of their stock. A few years ago the average poultryman or farmer was rather skeptical about a bird having the ability to lay 200 eggs in one year. The official trap-nesting done during the past few years has demonstrated that a good percentage of birds entered lay in the neighborhood of 200 eggs in a year. About 5% of the birds at the Second All-Northwest Egg-Laying Contest laid over 250 eggs each, while 31% of the birds laid over 200 eggs, and 71% over 150 eggs.—R. V. Mitchell, *Director, Washington Agricultural Experiment Station, Pullman, Washington.*

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[2] On pages 47–48 Dr. Toulouse expresses a doubtful belief in the superstition of telegony, which is now thoroughly discredited among geneticists.

A Pioneer Research in Correlation

Distribution by School Grades of the Weights of Boys Aged 9[1]

Grades (pounds)	Mentally inferior I	II	III	Mentally superior IV	V
78	......	4	......	......	......
77	......	1	4	......	......
76	......	5	3	1	......
75	......	1	1	1	......
74	1	5	2	......	1
73	1	7	4	......	......
72	3	5	4	1	......
71	3	6	4	2	......
70	7	16	6	1	......
69	5	10	6	1	......
68	1	17	6	......	......
67	1	21	10	2	......
66	3	29	8	2	......
65	11	22	14	3	1
64	21	53	18	2	......
63	17	44	22	4	......
62	25	63	13	......	......
61	25	54	23	4	......
60	29	72	21	3	......
59	29	61	16	2	......
58	27	74	23	3	......
57	37	65	17	1	......
56	33	62	14	1	......
55	39	91	21	3	1
54	30	72	18	2	......
53	39	78	10	......	......
52	33	52	18	1	......
51	28	50	14	......	......
50	25	48	10	1	......
49	20	28	6	1	......
48	14	24	4	......	......
47	19	14	1	1	......
46	8	8	......	......	......
45	13	11	1	......	......
44	7	7	3	......	......

ALL GOOD QUALITIES ARE CORRELATED

As far as known, all good qualities are correlated—that is, persons who are superior in one direction are likely to be superior in every other direction, exceptions to the contrary notwithstanding. This law is so important in eugenics and so completely in conflict with popular belief that insistence upon its truth is much needed. The above table, which proves that bright children weigh more than dull children, is reproduced from the transactions of the Academy of Science of St. Louis, March, 1893. It is the first table in a research made by Dr. William Townsend Porter on growing school children. The black lines near the center mark the averages and it can be seen that these rise like a perfect flight of stairs. All the boys were nine years old, but superior mentality was found correlated with physical development. A successive series of grades like the above is always a true test of a correlation. A further discussion of correlations within the individual and their relations to eugenics appeared in the Journal of Heredity for February, 1919.

[1] A few scattering figures relative to very heavy and very light boys are here omitted.

The Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918 and 1919. Vol. IX contains only 8 instead of 12 numbers, as will also Vol. X.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, November 24, 1919.

A BRANCH OF THE NEW FRENCH PRUNE TREE

Some typical fruits of the new variety of French prunes are here shown. These fruits (reproduced above to approximately one-half natural size) are about twice the size and weight of the ordinary variety, and are more uniform in all of their characteristics. The trees seem to have a more vigorous growth and develop larger leaves than the parent variety. (Frontispiece.)

ORIGIN OF A NEW AND IMPROVED FRENCH PRUNE VARIETY

A. D. Shamel

THE French prune, *Prunus domestica,* commonly called the *petite prune d'Agen* or little French prune, was introduced into California in 1856 by Louis Pellier, a nurseryman of San Jose, who brought the scions from Ville Neuve d'Agen, France, from which place the variety takes its name. The commercial development of this prune in California started about 1880. In 1918, according to the California State Commission of Horticulture, there were 100,721 acres of prune trees in bearing and 34,690 acres of young trees not in bearing. The production amounted to 39,127 tons with an approximate valuation of $5,500,000. The Santa Clara valley is the center of greatest production, having about 60,500 acres of bearing prune trees. In 1919 the very heavy crops, together with the high prices being paid for prunes, seem likely to establish a high record both for the amount and value of the crop.

During recent years the prune industry has developed extensively in the Pacific northwest, particularly in the states of Oregon, Washington and Idaho. Formerly, the growth of the prune industry was slow in these districts on account of difficulties in drying the fruits under natural climatic conditions. Recently, the drying of the fruits has been done successfully under controlled conditions with hot, dry air as the source of heat in the evaporators. This development seems likely to lead to an extensive culture of the prune in the northwest, where drying under natural conditions is frequently interfered with by fog and rain.

The Prune d'Agen variety, most generally grown in California, is particularly well adapted for prune production on account of the rich, aromatic flavor of its fruits, the dense, fine texture of the flesh, which gives the cured fruits tenderness both when used as a confection and when slightly cooked, and the smallness of the pits, together with their thinness and smoothness. The dried fruits frequently contain more than 50% of fruit sugars. Correlated with this sugar content is a high degree of spicy prune flavor. The color of the fruits of this variety is a royal purple, which is an important factor in the successful marketing of the dried prunes. The delicious, melting flesh separates easily from the small flat pit.

The trees of this variety are heavy bearers under normal conditions. Some fruit is usually borne the third year after planting. From the fifth year on, the trees may be expected to produce commercial crops. From 200 to 300 pounds are considered to be a satisfactory yield for a full-bearing French prune tree. However, 600 and even 800 pounds have been produced, and a six-year-old tree at Visalia, Cal., is said to have borne 1,102 pounds of fruit in one season.

The tendency to heavy bearing is frequently correlated with small size of fruits, particularly when the crops are not thinned at the proper time. If too much bearing wood is grown, the fruits are likely to be too small for satisfactory commercial purposes. For this reason there has been an active demand among prune growers for a larger French prune having the valuable characteristics of the established variety. Until recently all efforts to achieve this result seem to have been failures. The trouble with the larger fruited varieties, as a rule, is that the fruits are likely to be of poor quality, coarse, and stringy in flesh, or have large, undesirable pits.

Leonard Coates, nurseryman and

COMPARISON OF NEW AND ORDINARY VARIETIES

Typical leaves, fruits and pits of the two varieties are shown above, those of the new variety at the top and the ordinary variety at the bottom. The former are larger and more uniform than the latter. (Fig. 1.)

fruit grower of Morganhill, Cal., has been studying the problem of securing an improved variety of the French prune for many years. In the course of his experiments he has isolated several strains which differ from each other in one or more clearly recognizable characteristics. No attempt will be made at this time to discuss these various types and their relation to the original variety. This account will be confined to a description of the isolation, propagation and testing in an experimental orchard, of a strain which originated from a bud variation and which promises to be the larger fruited variety so long sought for by prune producers in California.

In 1904, in a French prune tree growing in an orchard near Saratoga, Cal., one branch high up in the tree was found bearing very large fruits. There is no question as to its being a true bud variation. Several grafts were secured from this branch and placed in bearing peach trees in order to secure early evidence as to whether this variation, or bud sport, could be propagated. The fruits produced by these grafts were found to be identical to those borne by the original branch. The large fruits possessed all of the desirable characteristics of the smaller fruits of the ordinary French prune and, in addition, possessed the desired improvement in size.

TYPICAL FRUITS OF THE TWO VARIETIES

The fruits shown in the left half of the picture are of the new French variety, and those on the right are of the ordinary variety. These samples were grown on neighboring trees in the same orchard. Note the cross-sections at the bottom. (Fig. 2.)

In order to give this strain a commercial test Mr. Coates bought 10 acres containing about 1000 peach trees for experimental trials of the large prune variety. These trees were five years old in 1914 at the time of their purchase. The large-fruited French prune variety was budded into every other row of the peach trees with the usual method practiced in top-working citrus and other fruit trees. Mr. Coates believes that budding is preferable to grafting for top-working peach or other stone fruits.

The top-worked trees with the improved French prune strain, called No. 1418 for convenience during the experimental stages, are in alternate rows with the ordinary or other selected strains of the parent variety. In other words, in the 10-acre experimental orchard there is one row of No. 1418 followed by a row of the parent variety, and so on throughout the entire orchard. The conditions are comparative and furnish the basis for a fair comparison of the No. 1418 strain trees with those of the parent variety.

The yield of the No. 1418 trees in the experimental planting has been more than double that of the comparative trees. The No. 1418 fruits are about twice the size and weight of the comparative fruits. They are more uniformly distributed throughout the tree than is the case with the fruits borne by the

comparative trees. Furthermore, the fruits are more uniform in size, shape and other characteristics than are the fruits of the ordinary variety. So uniform are the No. 1418 fruits that they appear to have been graded mechanically as to size as they lie on the ground after falling.

The No. 1418 trees appear to be more vigorous growing and develop larger leaves than do the comparative trees. The leaves of the trees of this strain appear to be thicker and have a tougher feel than do the leaves of the trees of the parent variety. In looking down the rows one notices that the larger trees of the No. 1418 strain, with their more luxurious and abundant foliage, stand out markedly as compared with the trees and leaves of the parent variety.

The fruits of the No. 1418 strain average about 25-30 to the pound as compared with an average of from about 50-60 to the pound as is the case of the fruits of the parent variety. The fruits of the No. 1418 strain drop clearly from the trees and are so firm that in a recent field examination no damage could be observed as a result of their fall. There was little or no bruising or other injuries observed in the fruits on the ground.

The fruits of the No. 1418 strain ripen at the same time as the fruits of the parent variety. They have the desired rich purple color, and on the drying trays this color shows as a very deep or dark purple. The flavor and other qualities of the No. 1418 fruits are said to be better than those of the parent variety by the manager of the principal drying organization in the district where the experimental orchard is located.

After the prunes are picked up from the ground they are dipped in a boiling lye solution with the aid of a large wire basket. After dipping in the lye solution the fruits are run over a sizing machine which assorts them into three grades according to size. Then the fruits are spread evenly in large shallow wooden trays and allowed to dry in the sun for from eight to ten days. Later, the trays are piled in stacks, where the drying and curing processes continue until finished. The handling of the prunes during the drying period requires care and experience. While kiln-drying is said to be successfully used in some districts, the manager of the plant where the prunes of the No. 1418 strain are dried does not believe it to be a commercial success under his conditions. The curing processes must be so managed as to preserve the rich, glossy color, meaty condition and high flavor essential to good prunes.

As a result of the favorable opinions expressed by propagators, growers, and driers as to the commercial value of the No. 1418 strain, Mr. Coates has decided to introduce it into as many prune-growing districts as possible in order to secure final information as to the range of its adaptability and value for commercial prune production. In this decision he is certainly justified by the experimental evidence in his test orchard thus far. If the improved variety proves to be equally valuable in other districts, it will undoubtedly be the most valuable addition to the commercial prune varieties ever introduced in America.

In carefully studying the individual trees of the new variety Mr. Coates has occasionally observed small branches, and in some cases individual fruit spurs, bearing the ordinary French prunes. The pyriform shape and other characteristics of the French prune, as contrasted with the more round or oval shape of the Coates variety serve to clearly distinguish the two types. While going over some of these trees recently with Mr. Coates, the writer found several similar branches, usually small ones, bearing several fruits which were unmistakably of the parent variety or ordinary French type, while the remainder on the trees were of the large Coates variety. This condition is additional evidence as to the origin of the variety as a bud variation from the ordinary French prune.

It should be noted in this connection that the experimental orchard has not been irrigated thus far. The conditions

THREE BRANCHES FROM THE SAME TREE

The above photograph shows some typical cases of bud variations. All of these branches were cut from the same tree of the new French variety. On the left is a branch bearing four new French prunes and one of the ordinary variety. On the right, the branch at the top has two typical new French prunes, and the one at the bottom, two typical ordinary French prunes. (Fig. 3.)

therefore are more natural than where irrigation is practiced. Furthermore, the fruits of both the Coates and the ordinary French trees were not thinned. While the crops on the trees of the new variety were much greater than those on the trees of the ordinary variety, the new fruits were about twice the size and weight of the ordinary ones.

Twenty years ago the prune was often the subject of many alleged jokes on the part of our breakfast humorists. As a result many of us in college boarding houses and elsewhere looked with disdain upon this healthful and delicious fruit. Those days are gone, never to return. The writer recently paid forty cents for a dish of prunes served on a dining car in California. The prune is no longer a joke. As the price has gone up we have learned to prize it more highly. Prunes are now shipped from California all over the world. They are even exported to that district of France from which the prune d'Agen variety came to us. It is the superior dried fruit, and one which is not only good to eat but has very great therapeutic value as well.

Until recently the writer had never tasted a fresh prune. When fully ripe, as they are picked up for drying the fresh prune is luscious. No other word describes it. To those who have never tasted the fresh prune there is a new delight in store. For those who cannot have this opportunity the stewed dried prune or the delicious prune pie is the next best experience.

POLYEMBRYONY AND SEX[1]

A Study of the Origin and Development of Mixed Broods in Polyembryonic Hymenoptera, and the Ratio in Production of Males to Females.

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INTRODUCTION

IN ANIMALS the term polyembryony has come to include all cases in which two or more individuals arise from a single egg during the course of its early development. There are two types of polyembryony: (1) Specific polyembryony or the habitual production of multiple embryos in a given species; (2) sporadic polyembryony, or the occasional production of multiple embryos in a species in which the egg typically differentiates into a single individual.

Sporadic polyembryony occurs in many different species among the higher forms. In fact, cases have been recorded for every class of vertebrates. To this type belongs the well-known uniovular, or identical twins of the human species. Such twins are enclosed in a single chorion and are therefore often referred to as monochorial or monozygotic. They are invariably homosexual. In contrast with these are biovular or dizygotic twins, which may be heterosexual. In such cases the two individuals are no more similar than brothers or sisters in a family born at different times, or than the individuals in a litter of a multiparous species. They are often called fraternal twins.

The interesting fact concerning monozygotic twins is their homosexual condition which is explained on the basis of the chromosome hypothesis of sex-determination. According to this hypothesis, if the egg is fertilized by a male-determining sperm the twins will both be male, but if fertilized by a female-determining sperm they will both be female. It is supposed that, after the egg has once been fertilized, sexuality is irrevocably fixed, and, no matter how many individuals may later develop from it, such individuals will be homosexual.

The early data collected on sexes among species exhibiting specific polyembryony also support the chromosome hypothesis. Thus the four embryos which develop from a single egg of the Texas armadillo (*Tatusia novemcincta*) are invariably of the same sex. The same is true for the larger polyembryonic litters of one of the South American armadillos (*T. hybrida*).

The other groups of dioecious species which show specific polyembryony belong to the parasitic hymenoptera. Because of the large number of individuals which develop from a single egg in certain of these insects, data on their sex ratios are of especial interest. Unfortunately, we have but very few exact data on the sex ratios of these insects. Bugnion ('91) was the first investigator to record such data. He reared and studied twenty-one polyembryonic broods of *Ageniaspis* (*Encyrtus*) *fuscicollis*, and found nine female broods and five male broods, and seven broods that contained both males and females. Of the seven mixed broods, three had males and females in about equal numbers, three had a large majority of males, and one had a large majority of females. Marchal ('04) studied sixteen broods of *Polygnotus minutus*. He found eight female broods, six male, and two mixed, one with three females and three males, and the other with three females and one male. Silvestri ('06) found, in one hundred and sixty broods of *Litomastix*, sixty-three female, ninety-two male, and five mixed

[1]Contributions from the Zoological Laboratories, University of Texas, No. 142.

POLYEMBRYONY IN THE CASE OF PARASITIC HYMENOPTERA

1. Newly formed carcass of Autographra, containing parasitic pupae. 2. Newly formed cocoon, containing carcass. 3. Older carcass. 4. Cocoon with normal pupa of Autographra. 5. Cocoon containing pupae which are turning black. 6. Empty carcass showing holes through which parasites have escaped. 7. Gall of Rhopalomyia. 8. Silhouette of female Paracopidosomopsis ovipositing in egg of Autographra. 9. Gall of Walshomyia. (Fig. 4.)

broods. He does not give the numbers of individuals for any of these broods.

In commenting upon the data recorded by Bugnion for *Ageniaspis,* Marchal points out that it is difficult to account for the four broods in which a large majority of individuals belong to the one or the other sex. He believes that such broods must arise from two (or more) eggs. He further believes that should two eggs, one fertilized and the other not, be laid in the egg of the host at slightly different times, the one first deposited might gain the upper hand in the matter of food, and thus prevent all but a few of the individuals arising from the second parasitic egg from reaching maturity.

During the past few years I have been able to study in detail the polyembryonic broods of three distinct species of parasitic hymenoptera. The first species studied was *Copidosoma gelechiae,* which is found in the larvae of the Solidago gall moth, *Gnorimoschema salinaris.* This moth makes the ellipsoidal galls on the stem of the marsh goldenrod, *Solidago sempervirens.* The second species investigated was *Paracopidosomopsis floridanus,* which lays its egg in the egg of the common cabbage looper, *Autographra brassicae.* Recently I have studied the broods of *Platygaster sp.,*[2] which is found in the larvae of two dipterous gall-makers of the mountain cedar (*Sabina sabinoides*). The two hosts are *Walshomyia texana* and *Rhopalomyia sabinae.* We shall present the data on the sexes of these three species in the order named.

SEX RATIOS IN COPIDOSOMA

A total of one hundred and sixty-two broods of this species have been reared and the sexes noted. Ninety of these were female broods, sixty-two male, and ten mixed. I shall here give only the summary of these data, since the details have been published elsewhere (Patterson, '15). On the per cent basis these data show that 55.56% of all broods are female, 38.27% male, and 6.17% mixed. The total number of individuals is 31,001, of which 63.41% are females and 36.59% males. The average number of individuals in female broods (198) is higher than in male broods (175). However, the range in the number of individuals in the several broods (from 25 to 395 in the female, and from 41 to 345 in the male) is such as to indicate that the average per brood is of little significance in determining the true sex ratio for the species. Obviously this must be based on the number of male and female polyembryonic broods. It would be easy to determine this ratio were it not for the uncertainty of the origin of some broods. If it be assumed, as all previous investigators have done, that each mixed brood is at least dizygotic, then, in accordance with the law of probability, some unmixed broods must also be of dual origin. Worked out on this basis, it is found that the ratio of females to males is 106 to 76, or a sex ratio of approximately 3:2.

The interesting point brought out in the study of these insects is the ratio of males to females in the ten mixed broods. These are listed in the following table:

TABLE I.—*Mixed Broods of Copidosoma.*

Brood	No. of individuals	Females	Males
1*	89	20	69
2	162	153	9
3	172	92	80
4	207	126	81
5	216	176	40
6	235	223	12
7	241	161	80
8	300	235	65
9	304	292	12
10	337	316	21

* An incomplete brood, owing to the fact that some of the larvae and pupae had been destroyed by a dipterous larva.

In each of the nine complete lots listed in the table the number of females is greater than the number of

[2] I am indebted to Dr. C. T. Brues, who kindly informs me that this species belongs to the genus Platygaster. I am also indebted to Dr. E. P. Felt for naming and describing the two hosts here referred to.

males, but in five of the cases (Broods 3, 4, 5, 7, 8) this difference is not so great but that the origin of each lot can be explained on the assumption that two parasitic eggs have been deposited in the egg of the host. In each of the four remaining broods (2, 6, 9, 10) females are greatly in excess of males, so much so that it is difficult to explain the origin of such broods on the basis of two eggs. It was this evidence, although meager in amount, that suggested the possibility that such mixed broods might be monozygotic, that is, the origin of males and females from a single fertilized egg.

SEX RATIOS IN PARACOPIDOSOMOPSIS

Three hundred and sixty-four parasitized carcasses of the *Autographa* moth have been collected from the field. Many broods of parasites have been reared from these in the laboratory. The sexes of the individuals in 177 cases have been studied. The results of these studies show that only 3 broods, or 1.7%, are pure female broods; 20, or 11.3%, are pure male broods; and 154, or 87%, are mixed.

The three female broods contained 1,089, 1,306 and 1,859 individuals, respectively. The male broods vary from 385 to 1,588 individuals, with an average of about 1,000. The mixed broods vary from 545 to 2,028 individuals, with an average of 1,246 per brood.

Sixty mixed broods, in which the sex of each individual was carefully determined, are listed in Table II, arranged in the order of percentage of males, from the highest to the lowest. In Table III are listed fifty additional broods, in which the percentage of males is based on an examination of 500 individuals in each brood. Reference to these tables will show that the percentage of males varies from 72.07 to 0.06, and further, that in over 58% of the broods less than 10% of the individuals in any given brood are males, while in 35% of the brood there is less than 3% of males. The most striking feature of these data is the fact that females are so frequently in excess of males. The significance of

TABLE II. *Mixed Broods of Paracopidosomopsis.*

Brood.	No. of individuals.	Females	Males.	% of males.
1	974	272	702	72.07
2	1,289	400	889	68.97
3	1,237	482	755	61.02
4	636	294	342	53.78
5	828	385	443	53.50
6	545	272	273	50.09
7	1,162	595	565	48.71
8	848	529	319	37.62
9	1,512	1,009	503	33.27
10	1,847	1,287	560	30.32
11	839	586	253	30.15
12	943	701	242	25.66
13	998	746	252	25.25
14	1,706	1,353	353	20.69
15	628	509	119	18.95
16	662	542	120	18.12
17	1,022	878	144	14.09
18	1,364	1,195	169	12.39
19	1,797	1,584	213	11.85
20	1,041	923	118	11.35
21	1,477	1,357	120	8.12
22	1,115	1,033	82	7.35
23	1,307	1,211	96	7.35
24	1,303	1,199	104	7.21
25	1,196	1,122	74	6.19
26	803	754	49	6.10
27	1,432	1,352	80	5.59
28	868	822	46	5.30
29	1,423	1,349	74	5.20
30	1,050	996	54	5.14
31	1,883	1,791	92	4.89
32	1,259	1,203	56	4.45
33	1,457	1,394	63	4.32
34	855	828	27	3.16
35	1,046	1,015	31	2.96
36	1,124	1,091	33	2.94
37	1,000	972	28	2.80
38	757	739	18	2.38
39	847	827	20	2.36
40	1,301	1,271	30	2.31
41	1,209	1,183	26	2.15
42	1,260	1,233	27	2.14
43	1,682	1,647	35	2.08
44	1,592	1,559	33	2.07
45	1,258	1,232	26	2.07
46	692	679	13	1.88
47	1,220	1,209	20	1.64
48	1,115	1,097	18	1.61
49	1,036	1,021	15	1.46
50	1,798	1,774	24	1.35
51	1,075	1,061	14	1.30
52	1,475	1,456	19	1.29
53	1,349	1,336	13	0.96
54	2,003	1,986	17	0.85
55	1,017	1,010	7	0.69
56	1,165	1,159	6	0.52
57	1,143	1,141	2	0.18
58	1,493	1,491	2	0.13
59	912	911	1	0.12
60	1,550	1,549	1	0.06

this will be discussed in a later section of the paper.

SEX RATIOS IN PLATYGASTER RUBI

I have reared 105 broods of *Platygaster*, 67 from the carcasses of *Rhopalomyia* and 38 from those of *Walshomyia*. These are listed in Tables IV and V. The total number of individuals is 1,616, or an average per brood of over 15. The broods from *Rhopalomyia* are distinctly larger than those from *Walshomyia*, the former averaging slightly over 18, the latter only 10.5.

This difference is probably due to the fact that the larva of *Rhopalomyia* is almost twice as large as that of the second host, and thus furnishes a better supply of food for the multiplication of embryos. The smallest brood found contained five individuals (Brood 68), the largest thirty-seven (Brood 21).

TABLE III.-*Mixed Broods of Paracopidosomopsis*

[Per cent of Males Based on a Study of 500 Individuals]

Brood.	No. of individuals.	% of males.
61	2,028	67.20
62	1,043	47.50
63	1,149	44.00
64	1,540	43.90
65	1,463	42.80
66	1,134	37.00
67	1,397	31.60
68	940	31.20
69	1,123	29.60
70	996	29.00
71	1,045	26.00
72	1,467	24.80
73	1,822	24.00
74	1,233	22.60
75	1,685	21.80
76	1,095	19.60
77	1,745	19.00
78	1,201	18.00
79	1,301	16.00
80	841	14.60
81	1,410	14.60
82	1,605	14.20
83	867	13.60
84	1,347	12.20
85	1,167	11.80
86	701	11.00
87	1,403	9.20
88	1,602	8.20
89	1,606	8.09
90	1,228	8.00
91	1,614	7.40
92	1,675	7.40
93	1,258	6.50
94	1,139	6.00
95	841	5.20
96	1,111	4.40
97	1,665	3.40
98	1,351	2.80
99	1,633	2.80
100	1,857	2.40
101	794	2.20
102	1,306	2.20
103	1,092	2.00
104	980	2.00
105	1,005	1.80
106	1,334	1.20
107	1,550	1.20
108	1,560	1.00
109	1,469	0.60
110	1,227	0.60

In many respects the data collected on *Platygaster* are the most interesting available for any polyembryonic species. So far not a single male brood has been found. Perhaps a larger collection of data would reveal such broods. The scarcity or absence of pure male broods can be explained as follows: The car-

TABLE IV.—*Broods of Platygaster from Rhopalomyia.*

Brood	No. of individuals	Females	Males	% of males
1	7	5	2	28.59
2	36	26	10	27.77
3	34	26	8	23.52
4	26	20	6	23.07
5	13	10	3	23.07
6	31	24	7	22.58
7	31	24	7	22.58
8	27	21	6	22.22
9	9	7	2	22.22
10	14	11	3	21.42
11	34	27	7	20.58
12	20	16	4	20.00
13	15	12	3	20.00
14	26	21	5	19.23
15	16	13	4	18.75
16	11	9	2	18.18
17	11	9	2	18.18
18	29	24	5	17.24
19	36	30	6	16.66
20	24	20	4	16.66
21	37	31	6	16.21
22	19	16	3	15.79
23	26	22	4	15.38
24	13	11	2	15.38
25	13	11	2	15.38
26	20	17	3	15.00
27	14	12	2	14.28
28	7	6	1	14.28
29	23	20	3	13.04
30	23	20	3	13.04
31	15	13	2	13.33
32	15	13	2	13.33
33	16	14	2	12.50
34	16	14	2	12.50
35	17	15	2	11.76
36	26	23	3	11.53
37	9	8	1	11.11
38	28	25	3	10.71
39	11	10	1	9.09
40	11	10	1	9.09
41	12	11	1	8.33
42	12	11	1	8.33
43	12	11	1	8.33
44	13	12	1	7.69
45	13	12	1	7.69
46	13	12	1	7.69
47	13	12	1	7.69
48	15	14	1	6.66
49	15	14	1	6.66
50	15	14	1	6.66
51	15	14	1	6.66
52	15	14	1	6.66
53	16	15	1	6.25
54	16	15	1	6.25
55	16	15	1	6.25
56	17	16	1	5.88
57	18	17	1	5.55
58	18	17	1	5.55
59	18	17	1	5.55
60	18	17	1	5.55
61	22	21	1	4.54
62	9	9	0	0
63	13	13	0	0
64	14	14	0	0
65	15	15	0	0
66	16	16	0	0
67	19	19	0	0

cass of the host which contains the parasitic pupae is formed in the chamber of the gall, and the parasites upon emerging are confined within the gall for some hours before they are able to gnaw an exit hole through the wall. In all of these polyembryonic hymenoptera copulation takes place immediately after the insects emerge, a single male often mating with many females. Since practically every brood has at least one male present, it follows that unfertilized females rarely escape into nature. It is known from cytological and experimental studies that eggs laid by virgin females produce only male broods. Under these conditions, male broods are not to be expected in *Platygaster*.

A second point of interest is the scarcity of pure female broods. Only six have been observed, and all of these were reared from the carcasses of *Rhopalomyia* (Broods 62 to 67). However, the chief interest in these data is to be found in the character of the 99 mixed broods. Without exception the number of females in any brood exceeds the number of males. In fifty-three broods, or more than half the cases, there is but a single male present. Seventeen broods have two males each, and thirteen three each. The remaining broods have varying numbers of males, the highest having ten (Brood 2).

TABLE V.—*Broods of Platygaster from Walshomyia*

Brood	No. of individuals	Females	Males	% of males
68	5	3	2	40.00
69	10	7	3	30.00
70	11	8	3	27.27
71	8	6	2	25.00
72	5	4	1	20.00
73	18	15	3	16.66
74	12	10	2	16.66
75	23	19	4	16.95
76	19	16	3	15.78
77	13	11	2	15.38
78	7	6	1	14.28
79	7	6	1	14.28
80	15	13	2	13.33
81	8	7	1	12.50
82	8	7	1	12.50
83	8	7	1	12.50
84	9	8	1	11.11
85	9	8	1	11.11
86	9	8	1	11.11
87	9	8	1	11.11
88	10	9	1	10.00
89	10	9	1	10.00
90	10	9	1	10.00
91	10	9	1	10.00
92	10	9	1	10.00
93	10	9	1	10.00
94	10	9	1	10.00
95	10	9	1	10.00
96	10	9	1	10.00
97	10	9	1	10.00
98	10	9	1	10.00
99	10	9	1	10.00
100	11	10	1	9.09
101	11	10	1	9.09
102	11	10	1	9.09
103	11	10	1	9.09
104	11	10	1	9.09
105	11	10	1	9.09

SIGNIFICANCE OF THE SEX DATA

In the light of these data, how is one to explain the origin of mixed broods in polyembryonic hymenoptera? The obvious explanation, and therefore the one offered by all the pioneer workers in the field, is what may be called the two-egg hypothesis. It is suggested that mixed broods have developed from two parasitic eggs, one laid by a fertilized and the other by a virgin female. Undoubtedly such dizygotic broods do exist. Several of the mixed broods listed in the tables can be adjusted easily to this hypothesis. It is to be expected that a host egg would occasionally be visited and parasitized by two such females. But there are at least two obstacles which stand in the way of the universal application of the two-egg hypothesis to all mixed broods.

I have elsewhere pointed out and discussed these difficulties, so that here they may be referred to briefly: (1) The individuals of a mixed brood emerge simultaneously; therefore, it is necessary to make the assumption that both parasitic eggs are always laid at the same time. (2) In the great majority of mixed broods females far outnumber males. This is strikingly so in the broods of *Platygaster* and *Paracopidosomopsis*. It must be assumed, then, that an unfertilized egg in the presence of a fertilized egg is inhibited from fully developing; because when laid alone in the host egg it produces a pure male brood, in most instances as large as a pure female brood. In the absence of experimental evidence for sexual hormonic action in insects, it is difficult to square the facts revealed by a study of mixed broods with the two-egg hypothesis.

POLYEMBRYONY IN PLANTS

Seeds of certain plants sometimes contain several embryos. The mango, the rose-apple (*Eugenia jambos*), and the citrus fruits are all known to possess this characteristic. Above are shown several plants arising from a single seed of the mango. It is presumed that one of the embryos develops from the fertilized egg-cell; the remainder are derived from the tissue of the nucellus by budding. These adventitious embryos produce plants whose fruit resembles that of the parent tree as closely as that of a grafted individual. By this means, in fact, numerous seedling races of mangos and citrus fruits are propagated in the tropics. (Fig. 5.)

Since we had been able to show experimentally that if the host egg is oviposited by a virgin female, the resulting brood of parasites is always male, but if parasitized by a fecundated female a mixed brood develops, the question was raised as to whether the female of *Paracopidosomopsis* deposits two eggs at one oviposition, and if so, whether the impregnated female (as does the queen bee) could lay unfertilized as well as fertilized eggs. If this were so, it might explain the appearance of numerous mixed broods in this species. These questions have been tested out by appropriate experiments, and it is found that in two times out of three, or in about 66% of the cases, the female parasite lays two eggs in the host egg at a single oviposition. If it is assumed that in every case one of the two eggs is fertilized and the other is not, there is still a discrepancy of over 20%, because 87% of all broods in this species are mixed. Furthermore, I have studied, by means of smears, the two eggs laid at one oviposition by the fecundated female, and find that in the majority of cases both eggs are fertilized. In a few eggs it is difficult to demonstrate the presence of the sperm, although a failure to do so does not necessarily indicate that such eggs are unfertilized; because the position of the egg on the slide may be such as to obscure the sperm.

In this connection the conditions in *Platygaster* are very interesting. The host egg for this species is too small for smear preparations, so that it is necessary to resort to sections in order to determine whether the parasite deposits one or two eggs. The host eggs, which are usually laid in masses, were exposed to a mixed brood of parasites, and sections then made of these masses. Some of the eggs will, of course, be parasitized by more than one female, but the position of the eggs in the yolk of the host egg will show whether there has been more than one oviposition. In a group of 28 eggs the following data were obtained: Each of 14 eggs contains one parasitic egg; each of 11 contains two; and each of 3 contains three. In eight cases out of the eleven the two eggs are far enough apart to indicate two ovipositions, while in three cases they are close together, suggesting that the two eggs may have been laid at one oviposition. In each of the three remaining eggs the three parasitic eggs are not close together.[3] In view of these facts it is impossible to explain the origin of mixed broods of *Platygaster*, tabulated in Tables IV and V, on the two-egg theory.

The suggestion has been made (Patterson '15, '17*a*) that the appearance of so many mixed broods in some of the species of polyembryonic parasites may be accounted for on a monozygotic basis, namely, that a fertilized egg gives rise to males as well as females. This result could be brought about through the abnormal behavior of the two sex chromosomes during the early cleavage divisions of the egg. There are several different ways in which this might occur, but the most probable way is by the means of somatic non-disjunction (Bridges, '16). If this process should occur, certain blastomeres receiving but a single X chromosome would become the progenitors of male embryos. The sex ratios in the broods of Polygnotus in particular are more easily accounted for on this basis than by the two-egg hypothesis. This is especially true with reference to the large number of broods which show but a single male. The regularity with which certain sex ratios appear in many broods (*e. g.*, 9 females and 1 male. Broods 88 to 99) suggests that a single male is formed at some very definite point in the early development of the eggs. If somatic non-disjunction does occur during the early cleavage stages, it might be regarded as a very primitive type of paedogenetic development, in which some of the early blastomeres, functioning as egg cells, produce abnormal behavior of the sex chromosomes in the cleavage division.

[3] For these data I am indebted to Mrs. Lelia T. Porter, who is studying the development and cytology of these insects.

A non-disjunctional division in any of the first few blastomeres will necessarily result in the segregation of the sex factors (producing male and female), provided the cell in which it occurs has not reached the point beyond which it becomes the progenitor of a single embryo. If a blastomere has once passed beyond this point in its development, a non-disjunctional division in any of its descendants should result in the formation of a gynandromorph or mosaic, as several writers have interpreted the origin of gynandromorphs for the monembryonic egg. Evidence that gynandromorphs are produced in polyembryonic parasites is furnished by two cases which have come under my observation. In 1917, while studying a brood of *Paracopidosomopsis,* I found an individual in which one-half of the abdomen is male and the other half female. This spring I found a specimen in *Platygaster* which is clearly a gynandromorph. Sexual dimorphism in this species is very indistinct. The only clear mark of distinction is the antennae, which are somewhat stouter in the female than in the male, and, furthermore, the fourth antennal joint in the male is enlarged. The specimen in question has a male antenna on the left side of the head, and a female antenna on the right.

The final solution of the question concerning the origin of mixed broods must be found through cytological studies. However, one may attempt to interpret the data presented in this paper, the facts at any rate are perfectly clear and can be verified by anyone who will make a careful study of these insects.

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Estimating Intelligence

There is a general belief that it is a relatively easy problem to estimate a person's intelligence by looking at him; and teachers, physicians and employers are often compelled to make judgments as to the intelligence of a given person with no more data than can be obtained from a rapid survey of his appearance; hence such phrases as "he looks bright" or "he looks stupid." Even in the law courts rough estimations of intelligence are sometimes required. In the *Psychological Review* (Vol. xxv, No. 4) Mr. R. Pinter gives the results of an investigation he made for the purpose of testing the trustworthiness of these judgments. The author chose twelve photographs of children varying in intelligence from proved feeble-mindedness to unusually great ability, and asked groups of people to arrange the photographs in order of merit for intelligence. His groups consisted of physicians, psychologists, teachers and miscellaneous people. He found that the group of psychologists was the most nearly correct, but that on the judgment of no one group or of no one person could any reliance be placed. Several observers were consciously influenced by children of their acquaintance whom a photograph happened to resemble, and irrelevant trivialities quite frequently biased the observer's judgment. The author concludes that, although perhaps a living person would be easier to judge than a photograph, nevertheless these haphazard judgments are too untrustworthy to be of practical value; and that, whether the observer be a teacher, physician, or employer, it would be better to use objective standards, and he recommends that the use of mental tests should be considerably extended.—*Nature.*

WHY SHOULD NOT CEMETERIES PRESERVE OUR LIFE RECORDS?

A Plea That Cemeteries Should Become the Historic Spots Where the Records of Our Deeds and Our Likenesses Are Preserved

David and Marian Fairchild

WHY should not our cemeteries be something more than the mere resting places of our bones? The savage tribes of Borneo bury their dead with quite as much ceremony as that with which we escort the remains of those dearest to us to the grave. They erect sticks over these burial places, and they soon forget them, just as we do.

Who has not hunted in vain through a great cemetery for some granite shaft that looks almost like scores of others, but which is precious because it witnesses the spot where some earthly form loved when alive disappeared forever into the earth from which it came. Scattered in more or less orderly groups over a hillside lie these spots, each sacred to some one, each visited perhaps on birthdays or marriage days by the living souls in whose memory the image that lies buried is slowly fading.

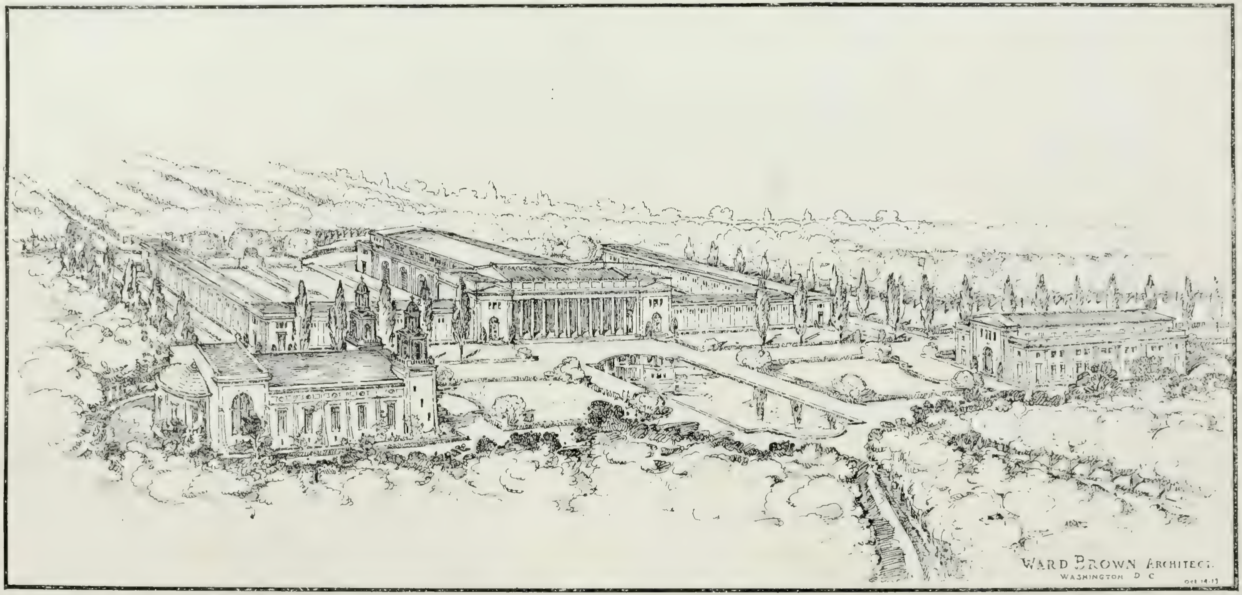
Sad places are these which mark man's disappearance beneath the sod, but, sad as they are, why should they be so hopelessly useless? Our dead are buried in them, and their bones are protected from molestation perhaps for centuries, but is that not really all? In a hundred years, a sinking gravestone, a name and date that are hard to read, and perhaps an epitaph—though now these are few—are the most we can get from any cemetery.

Yet these are the most sacred spots of the human race. Every career ends in one; that of the greatest human being who has lived as well as the smallest finds its close somewhere in a graveyard.

This has been for centuries, and is today, the attitude of our minds towards cemeteries, but has not the time come when a different point of view regarding them is possible? The theories of descent and of the continuity of the germ plasm have brought the realization that the living descendants of the dead are imperishable parts of them which go on living on this earth, and are an extension, a projection, of the life which shone out through the eyes and found expression in the voices of forms which lie buried beneath the cemetery sod. To know, to understand those who are living, we must know about the dead who bore them. It is not only the very few distinguished members of a family who leave their mark upon their descendents; we are just as much influenced by those who live their lives quietly and having done nothing spectacular, pass away without leaving any account of themselves in literature or art or business.

This growing conviction that we cannot understand people unless we know their ancestry is making it more and more necessary that the records of our ancestors be kept, but where? The most sacred spot appears to be that beneath which they are buried, but, as the graveyard is organized today, this spot reveals nothing whatever—teaches nothing. It is the spot of all most terrible to visit, for it is there that we gaze into the abyss of death—and wonder. Need this be so? Need our graveyards be, so far as teaching is concerned, as silent as the barbaric graveyards of the savage tribes? Can we not arrange to have them instead storehouses of all possible information about the dead who are in them?

The Pharaohs of Egypt thought to live on into eternity, and day by day



A PLACE FOR THE PRICELESS FAMILY RECORDS

"Let us picture in our imaginations such a graveyard as could be made, providing someone who could do it were convinced of its value. Somewhere in it there would be a beautiful building—as beautiful as art can make it—and in it a series of halls with alcoves and quiet places like a great library. Instead of books, however, there would be stored away in fireproof vaults the priceless records of the men and women—the families—who lie buried in the cemetery, and at any time these would be available to any one who had a right to them . . . There would be photographs and accounts . . . so that we could get an actual, tangible idea of the family. It would help us realize our place in the family and our responsibility to it." (Fig. 6.)

built their tombs more deeply into the solid rock, inscribing on the walls their deeds. They left accounts of themselves which thousands of years later have been deciphered and have revealed their lives. What they did five thousand years ago, and for a different reason and at great expense, the poorest of us now might do, leaving our images in the silver, of photographic prints, and accounts of what we did and who we were to guide mankind in its long studies of that great science of inheritance. What it required hundreds of slaves to accomplish in the days of the Pharaohs, the printing press and the camera can do for us all.

This record of life is made for many of us, but the accounts are scattered after we are dead, and our graveyards, instead of being the places where our deeds are recorded and where those imperishable shadows, our photographs, may be seen, are cold, dreary, silent and speechless.

We cannot help feeling that those who control our cemeteries have an opportunity here to exert a truly great influence for the betterment of our race. If they should gather for all who are buried in their confines all the data available at the time of the person's death, including photographs, and store this data as our libraries store books, having it in shape for easy display, would not such places become the centers of information regarding the stocks from which we came? A system of exchange could easily be worked out which would make it possible to trace the heredity of all.

There comes to most of us at some time the desire to see where our ancestors are buried, and we go to some New England village cemetery, or perhaps to some little churchyard abroad and succeed in finding the gravestones. Perhaps in the church warden's registry or the town clerk's office we find recorded the birth or marriage or death

"Sad places are these which mark man's disappearance beneath the sod, but sad as they are, why should they be so hopelessly useless? . . . In a hundred years, a sinking gravestone, a name and date that are hard to read, and perhaps an epitaph—though now these are few—are the most we can get from any cemetery." (Fig. 7.)

of some one of our name. What a satisfaction it would be if instead we could go into some quiet room and have brought to us to look at, to hold in our hands and to show to our children the actual photographs of our forefathers, the accounts of what they had done, little incidents of their lives, anything which gives them a real personality for us and strengthens our interest in the family.

Let us picture in our imaginations such a graveyard as could be made, providing someone who could do it were convinced of its value. Somewhere in it there would be a beautiful building—as beautiful as art can make it—and in it a series of halls with alcoves and quiet places like a great library. Instead of books, however, there would be stored away in fireproof vaults the priceless records of the men and women—the families—who lie buried in the cemetery and at any time these would be available to any one who had a right to them and they could be taken in to one of the rooms or alcoves to be looked over and studied. There would be quiet reading rooms and special viewing contrivances where moving pictures of families could be seen and places fitted up so that phonographic records of the voices of the past could be heard. There would be photographs and accounts also of the uncles and aunts, and of the little children who died young, so that we could get an actual tangible idea of the family. It would help us realize our place in the family and our responsibility to it.

There need be nothing dreary or morbid about such a place, indeed if it were so the whole object would be defeated. It should be the natural place to which one would take visiting relatives and those who were coming into the family by marriage, and the children would go too and realize that it means something to belong to a family, that it is a pleasant thing to be proud of one's family and that one would like to add to the family prestige oneself.

Visits such as these would give a background to our lives—would tie us to the past and also make us realize that to our children must come the burden and the pleasure of passing on the light of our lives into that great and wonderful future *upon this earth* in which increasing millions of babies still unborn must live their lives, let us hope, as happily as *we* have.

At funerals and at weddings families gather together, but we part again too often without strengthening the ties which would bind us to the past and make us feel that pride of family which must be at the bottom of the making of a better race. First, better families, then their spread and increase, and through them a gradual raising of the level of the whole race. It is the only way unless the laws of heredity are a myth.

To lay up treasure for ourselves in heaven is one thing, but is it not quite as noble to try to do things now which will make the earthly lives of future generations happier and more spiritual and more wonderful?

If we are to make the world better; if that is one of the reasons for our existence, why is not the establishment of these Libraries of Family History, a really constructive way of doing it? Why does not someone do it?

A SUPPOSED SHEEP-GOAT HYBRID

A Remarkable Skin Secured by a Trader from the Navajo Indians of Arizona

FIGURE 8 shows a very remarkable skin which has been received from Mr. J. W. Bush, of Castle Butte, Arizona. This skin seems to partake of the characters of both the sheep and goat.

The color is a mixture of light brown and white on the back, sharply distinct from a very dark brown color on the belly. The legs are largely dark brown with, however, a streak of light brown in front. Except for the irregular areas of white on the back, the color and pattern closely resemble the Barbados sheep. A similar pattern occasionally appears among Rambouillets, as in a case described by L. L. Heller in THE JOURNAL OF HEREDITY, vol. vi, No. 10 (October 1915).

The sheep of Arizona are very much mixed in color. According to an estimate, 15 to 20% are dark colored. The color of the skin thus might well be that of a sheep or sheep hybrid. The brown color is also, of course, common among goats.

The coat is largely composed of short coarse hair. In many places there is a soft, woolly undercoat. In small patches on the shoulders, along the back and on the belly, this wool has accumulated in tangled mats. On the hind quarters the wool becomes more hairlike, but is much finer than the hair in the same part of the coat, as well as much longer, reaching a length of four or five inches. The tail is entirely covered with fine hair or coarse wool of this character. It is somewhat coarser than Lincoln wool. Below is Mr. Bush's account:

"Under separate cover I am sending you a hybrid goat-sheep skin.

"The skin was presented to me more than a year ago by Mr. E. J. Marty, who is engaged as trader with the Navajo Indians at Indian Wells, Arizona. . . .

"This is the result of a cross between a native (Mexican) goat and a sheep, the original owner of which I have been unable to locate, as the skin was sold by some Indian without special notice taken of it at the time.

"I have shown it to many of our oldest Indians and all say they have never seen anything like it before."

In view of the rather unsatisfactory history, it can hardly be definitely affirmed that this is a sheep-goat hybrid. Yet it seems unlikely that the patches of wool could come from a goat, nor could the coarse hair coat come from a sheep. Sheep-goat hybrids are certainly not common, and it has often been denied that they can be produced at all. They are occasionally reported, however. One such case was reported by W. E. Spillman in the *American Breeders' Magazine*, vol. iv, No. 1 (1913).

It is to be hoped that this question of the occurrence of sheep-goat hybrids will be settled by experiments which leave no doubt in regard to parentage.

SKIN OF THE SUPPOSED SHEEP-GOAT HYBRID

The color is a mixture of light brown and white on the back, sharply distinct from a very dark brown color on the belly. The pattern closely resembles that of the Barbados sheep. (Fig. 8.)

DETAILED VIEW OF SKIN SHOWN IN FIG. 8

The coat is largely composed of short, coarse hair but in many places there is a soft, wooly undercoat. In small patches this wool has accumulated in tangled mats. On the hind quarters the wool becomes more hair-like. (Fig. 9.)

DEMOCRACY AND HEREDITY—A REPLY

Alleyne Ireland

GOVERNMENT, as an art and a science, is the only mundane subject which, from a period antedating the Christian Era, has engaged the earnest attention alike of philosophers and men of affairs. But at no time in recorded history has government been a matter of personal concern to so large a proportion of the world's inhabitants as it is today. It is in the domain of government alone that all the secular interests of the rich and the poor, of the strong and the weak, of the wise and the foolish, of the young and the old, of the industrious and the idle, of the sick and the hale can be marshalled in a single category.

In relation to the problems created by the war the broad question of government assumes, therefore, an importance which the general public, even in face of its preoccupation with immediate economic and industrial difficulties, is beginning to recognize.

To a lifelong student of government, the signing of the armistice in November, 1918, with its promise of an unprecedented strain upon all national administrations, appeared to mark the arrival of a moment when thoughtful people would welcome a discussion of government which aimed rather to explain general phenomena than to attack or defend particular administrative projects. Accordingly I sent to the Journal of Heredity an article entitled "Democracy and the Accepted Facts of Heredity," which was printed in the issue for December, 1918, and was discussed in the May and June issues of 1919 by Prof. Edwin G. Conklin, of Princeton University; Mr. Madison Grant, Mr. Prescott F. Hall, Prof. O. F. Cook, and Mr. Robert Carter Cook.

It will serve the convenience of all readers of this article if I compress into a few paragraphs the gist of my first article. I stated, in effect:

1. That my observation of government in a score of countries had convinced me that, with few exceptions, the best governed countries were those in which the mass of the people had the least control over the administration of public affairs.

2. That in all worldly activities, save only those linked with politics, expert knowledge and firm leadership are universally recognized as the sources of success.

3. That in political matters we adopt the opposite principle, namely, the control of the expert by the inexpert.

4. That this amounts in practice to the substitution of a quantitative for a qualitative foundation for authority.

5. That the worse become the consequences of applying this principle the louder do we call for its wider application.

6. That this is the expression of a rhapsodical or irrational attitude toward the democratic form of government, in conformity with which we attach more importance to the form than to the results of government, and refuse to draw the only logical conclusion when these results are, over a long period and over a very wide area, patently and increasingly unsatisfactory.

7. That my dissent from the conventional view of democracy (as we practice it) as a sound, political principle was based upon four main considerations:

(*a*) That the individual and not the mass has been the main source of human advancement.

(*b*) That mental and moral traits in the individual are derived chiefly from heredity and not from environment.

(*c*) That acquired characteristics are not inheritable.

(*d*) That the general mating—through the pressure of social propinquity—of the more intelligent with the more intelligent, and of the less with the less, tends to make talented strains more talented and to depress other strains further and further below the line of mediocrity.

The central idea of my article was that, if my biological statements were true, the conclusion was inescapable that efficiency in government could not arise from or be made to depend upon its democratic quality, the word "democratic" being employed by me, of course, to express democratic experience during the past twenty centuries, and not democratic hopes for the next twenty.

Of the four articles which discuss the views here advanced, two are written by men whose professional work has made them specially familiar with biology, and two by men who, from similar causes, are specially familiar with affairs. The biologists endorse the greater part of my biological statements, whilst strongly dissenting from my application of them, and the men of affairs endorse the greater part of my statements on government. The satisfaction with which I contemplate this situation may be measured by considering the position I would have been in if the principal support for my views on government had come from the biologists, and for my views on biology from the men of affairs.

I do not suggest that a biologist may not have studied government to good purpose, or a man of affairs biology; and, in common with all readers of the JOURNAL, I am aware that Mr. Madison Grant, the lawyer, enjoys an international reputation as an anthropologist, and that Professor Cook, the botanist, is well known as an authority on African colonization.

Before taking up those points on which the discussion has disclosed marked differences of opinion it is advisable to refer to one on which there seems to be substantial agreement, namely, the extremely unsatisfactory state of American democracy after nearly a century and a half of free operation under conditions more favorable in most respects than those under which any other democracy has ever functioned.

As Professor Conklin opens his reply to me with a reference to his article on "Biology and Democracy" in the April, 1919, issue of *Scribner's Magazine,* I may quote from it his description of present-day democracy in this country:

"Our lack of specialization is reflected in our contempt for specialists and experts of every sort. The belief is widespread that one man's opinion is as good as another's and that expert knowledge is merely another way of fooling the people. We intrust education to those who can find no other occupation, apparently with the idea that anyone can teach. We leave the control of food, fuel, clothing, and other necessaries of life to speculators and middlemen, and the health, happiness, and employment of the people to Providence or to selfish exploiters. . . . We elect demagogues and grafters to political office so frequently that the very name 'politician' has come to be a reproach. We send narrow partisans to Congress, and, by stupid adherence to party regularity, men wholly untrained in statesmanship are frequently put into the most important public places."

After reading the foregoing description of American democracy as it appeared to Professor Conklin's *observation* in April, 1919, it was not without astonishment that I read his *judgment* of American democracy as expressed, also in April, 1919, in the JOURNAL OF HEREDITY, where he concludes his reply to me with these words: "After all the merits of any system of government should be measured by its actual results on society as a whole, over long periods of time, and measured in this way democracy has no cause as yet to be fearful of the results."

If the results to date of American democratic government, as Professor Conklin describes them, are no cause for fear; it is not easy to imagine upon what kind of results a just apprehension might be founded.

I do not know to what extent Prof. O. F. Cook and Mr. Robert Carter Cook find themselves in agreement with Professor Conklin's scathing indictment of the present state of American democracy; but they have, in their article in the JOURNAL for June, 1919, launched an indictment of their own against democracy as it is, which, though much shorter than Professor Conklin's, is more comprehensive and more formidable. They say: "The need is to give special ability or usefulness a selective value, to preserve and increase the family stock, but our system works generally in the opposite direction of using up and exterminating talent as rapidly as possible." and, in another connection, "our tendency is to restrict ourselves further and further toward mediocrity and inferiority."

The authors of these observations reach a conclusion not less astonishing than that reached by Professor Conklin from his observations, namely, "Our experiment in democracy is very different from any that preceded it, in being aimed toward scientific government."

It is not incumbent upon me, I am glad to say, to reconcile this statement with Professor Conklin's statement about our contempt for specialists and experts of every sort, or with his declaration that "almost every citizen thinks that he could solve complex problems of government ranging all the way from international relations to parochial affairs better than those who have devoted years of study to them."

I may dismiss this phase of the discussion by asking the reader to judge in what measure the observations of Professor Conklin, of Professor Cook, and of Mr. Robert Carter Cook, when considered in relation to the judgments they found on them, justify the following paragraph in my first article:

"Those who assume the task of reconciling the facts of democratic control with its theory adopt an expedient which places the whole issue beyond the reach of reason. They lay down the rule that democracy must not be judged by its yesterday or by its today, but by its tomorrow, and that so fast as tomorrows become yesterdays even so fast must all adverse evidence be discarded as worthless. Just below the ever-receding horizon of time there lies, almost in sight of those who accept this rule, the pleasant land where education and dietetics shall have made the majority of mankind into political units from which there can be built up a government of benevolence, righteousness, and efficiency."

It is when my critics, my supporters, and myself seek to account for the existence of those evils which we unite in deploring that we separate into two camps, one affirming that the causes lie fundamentally in the operation of biological law, the other that they do not, the negative position being taken by the biologists.

The real issue, when stripped of all dialectical trappings, is whether good government (however it may be defined) depends ultimately upon good human qualities or upon good political machinery. If it depends chiefly upon the former, all discussions of government must be founded in biology; if upon the latter, the discussion must center around constitutional law and political technique.

My own view is that since government forms are merely the instruments through which men administer their public affairs, the essence of government is to be sought not in the shape of the instrument—still less in its name—but in the character of those who employ it.

Viewed from this standpoint the distinguishing mark of modern speculations on government seem to me to be a constant effort to find in political machinery a substitute for human character, and a persistent determination to attribute all failure in government to any cause rather than to the widespread distribution of stupidity and corruption in man.

It is a most curious circumstance that Professor Conklin, Professor Cook and Mr. Robert Carter Cook should describe the present state of democracy in terms which imply a widespread dis-

tribution of stupidity and corruption; should agree that mental and moral qualities, such as stupidity and corruptness, are chiefly derived from heredity; should agree that acquired characteristics, such as may result from secular education and religious training, cannot be transmitted through heredity; and should also agree that there is no essential connection between biological law and the amount of stupidity and corruption in democratic government.

What is not less curious is that none of the dissentients from my hypothesis, that in a democracy like ours the character of the government depends chiefly on the character of the people, and that the character of the people is determined chiefly through the operation of biological law, states, in his reply to me, by what other causes, in his opinion, the quality of government is in fact determined. Indeed, so far as these gentlemen do assign causes for bad government—and they say very little on this point—they assign causes which are of a biological nature.

For instance, Professor Conklin says: "Many faults of democracies are not so much results of the form of government as of the condition and character of the people." But surely character is a biological factor. Again: "A democracy no less than an autocracy is a government by leaders, but in the former case these leaders are chosen by the people and are responsible to them and in the latter they are not. . . ." But surely, whether the leader be good or bad, whether he be elected by the people or appointed by a king, the qualities of his leadership are not conferred upon him by his appointment or election, but are derived from his mental and moral characteristics; and these, as most biologists, including Professor Conklin, agree, are derived chiefly from the operation of heredity; which brings us back again to biological causation.

Professor Cook and Mr. Robert Carter Cook complain that we do not give special ability and usefulness a selective value and that our tendency is to "restrict ourselves further and further toward mediocrity and inferiority." But mediocrity and inferiority are admittedly derived chiefly from heredity; and the fact that ability and usefulness are not given a selective value under our democratic system can only be due to the ignorance and stupidity of the mediocre and inferior majority which exercises control by force of its numbers.

A logical consideration of these truths should, it seems to me, have led their authors to a conclusion closely similar to that expressed in my first article, namely, that the majority of people being mediocre or inferior, it is unreasonable to expect that majority to provide a government which will not be mediocre or inferior. But so far from reaching any such conclusion, they describe my inferences as "reactionary" and "archaic," compare me with "another disillusioned specialist in government," and, having for the purpose of destroying one part of my argument, stated their conviction that we are breeding toward mediocrity and inferiority, they reprove me for not "looking forward to a world of capable, right-minded people. . . ."

Now, as a matter of fact, my sincere hope, though hardly my confident expectation, is that we may some day see a world in which capable and right-minded people shall exercise a much greater power in government than they now do. This hope is founded on the opinion that the two extremes of capacity and incapacity, of right-mindedness and wrong-mindedness, are, through the operation of assortative mating, becoming more distinctly separated from each other in the social scale, and that the more clearly this becomes evident the more likelihood there will be that special ability and usefulness will be given a survival value in our political system.

This brings me to a discussion of the only purely biological point on which my critics and myself are not in agreement—the effects of assortative mating.

I was careful to say in my former article that this was a point upon which biologists alone were competent to ex-

press an authoritative opinion. I must still leave the determination of this question with the biologists; but Professor Conklin having called for the evidence upon which my tentative opinion was based, I am glad to furnish it.

My statement appeared to me to be justified by the results of two investigations into the social distribution of genius and talent in the United Kingdom. The first was made by Prof. Havelock Ellis; the second, which is in continuation of the first, by Dr. Frederick Adams Woods. The material worked over in each case was furnished by the "Dictionary of National Biography" and by the successive supplements to that work. The former investigation is embodied in Ellis's "Study of British Genius"; the latter is not yet in print.

What these investigations disclose is that over a period of several centuries there has occurred a striking and progressive decline in the cultural contribution from the "lower" classes, and, of course, a corresponding relative increase in the contribution from the rest of the population.

It appears that, from the earliest times to the end of the nineteenth century, the contribution to eminent achievement made by the sons of craftsmen, artisans, and unskilled laborers yielded 11.7 per cent of the total number of names utilized from the "Dictionary of National Biography"; that the representatives of that class who were born in the first quarter of the nineteenth century yielded 7.2 per cent of the names; and that those born during the second quarter of the nineteenth century yielded only 4.2 per cent of the total.

These figures are of great interest when they are considered in relation to the social and political history of England during the nineteenth century.

Everybody knows that in England the nineteenth century witnessed a rapid and all-pervading democratization of social and political conditions. It was during this century that the English parliamentary system became, for the first time in the six hundred years of its existence, an institution representative of the great mass of the people; that schooling was made available for all; that in industry, in politics, in society, the gates of opportunity were opened wide for any person of whatever parentage who could make any contribution in any field of achievement; that peers became business men, and business men peers; that any scientist, any scholar, any painter, sculptor, musician, poet, novelist, actor, dramatist, engineer, chemist, architect, shipbuilder, lawyer, or merchant, whose talents had made him prominent in his calling, could entertain a reasonable hope of finding wealth in the favor of the public and a title of nobility in the appreciation of the political leaders.

In England in the nineteenth century, then, there were to be observed, in a measure never before attained in any age in any country, the conditions which give every man a chance, according to the qualities of his mind and temperament. If social opportunity was less free than in the United States, political opportunity was very much greater—a fact which can be verified by anyone who will take the trouble to compare the number of professions and occupations represented in the House of Lords and in the House of Commons with the number represented in the Senate and the House of Representatives at any moment during the past fifty years.

With every circumstance of life growing constantly more favorable to the self-assertion of genius and talent in the "lower" classes in England, how was it that the contributions to eminent achievement from that group fell from an average of 11.7 per cent of the total to a proportion of 4.2 per cent?

It seems to me that as the vast improvement in environmental conditions had not only failed to produce an increase in high achievement by those whom this improvement had done most to serve, but had, on the contrary, taken place *parri passu* with a very serious decline in achievement, the cause must be sought in an influence strong enough to offset whatever beneficent effects im-

proved environment might actually exert upon a stationary class during a single generation.

This influence I deem to have been that of assortative mating. Its operation appears to have been of a dual character. On the one hand, the effect in heredity of intelligence mating with intelligence and of stupidity mating with stupidity—to put the matter roughly—has been to perpetuate and to increase these opposite traits in the respective groups. On the other hand, the practical social consequence of these effects being produced under conditions of an ever-widening democratization of life has been that the more intelligent and talented elements in the "lower" classes have constantly been rising out of their class into one socially above it, and that this movement is draining the "lower" classes of talent and genius, tion, is increasing the genius and talent of each succeeding upper layer in the and, through a process of social migrasocial series.

Now, if assortative mating really occurs, as an inevitable consequence of social propinquity, and if democratic opportunity does actually enable a family to move upwards in the social scale, those who question the soundness of my inferences from these facts are placed in a curious dilemma.

If they admit the existence of assortative mating as an ordinary, everyday occurrence, they must, it seems to me, either deny the part played by heredity in determining the character of offspring or renounce the view that gence and penalties for stupidity. If democratic conditions have any tendency to provide rewards for intellisuch rewards and penalties are in fact apportioned, there must of necessity exist a constant upward and downward genetic pressure tending to produce an increasing difference between the two ends of the social spectrum; if such rewards and penalties are not among the consequences which follow the application of democratic principles then, so far from democracy presenting to every man a better chance in life, it must have the effect of placing a premium on inefficiency and a handicap on talent.

Professor Cook appears to accept the latter alternative when he says: ". . . our tendency is to restrict ourselves further and further toward mediocrity and inferiority. . . . The need is to give special ability or usefulness a selective value, to preserve and increase the family stock, but our system works generally in the opposite direction of using up and exterminating talent as rapidly as possible."

I may point out that, viewed in its relation to the future of democratic government, this statement describes a condition much more unfavorable than that which would exist if truth were found to lie in my hypothesis of an increasing intelligence and ability at one end of the social scale and of an increasing stupidity and incapacity at the other. In the former circumstances there could be found no reasonable hope of improvement; in the latter there could be discerned at least the possibility that the balance of political power might some day be transferred from numbers to intelligence.

Professor Conklin appears to regard my general argument as leading to the conclusion that the world should, in my opinion, be ruled by a fixed hereditary class; and he refers to "a real movement against fixed hereditary classes."

To whatever extent this movement is effective it claims my hearty support; but my support is entirely dependent upon the appearance in the phrase of the word "fixed." Wherever an hereditary class has become fixed—as was notably the case in Austria—the consequences have been disastrous, and for a very simple reason, namely, that such a "fixed" class cannot draw into its genetic reservoir the best elements of other classes.

In my judgment, the separation of society into classes—a phenomenon to be observed in every society, whatever may be its cultural or political status—is not only inevitable under all circumstances, but is highly beneficial wherever there is assured a free social migration from class to class. As man is con-

stituted—and one has only to compare the satire of Aristophanes with that of Bernard Shaw to be convinced of the permanence of his general characteristics—no greater stimulus can be afforded to talent and industry in the individual than the certainty that their diligent application will keep in a higher social order those who are already there and will carry into a higher social order those who are born in a lower.

In conclusion I may refer to the unanimous dissent expressed by my biologist critics from my conviction that the best governed countries are those in which the mass of the people have the least control over the administration of public affairs.

I cannot do more in this place than somewhat extend my former statement of this conviction, for it will readily be appreciated that a full discussion of comparative government would not be acceptable to readers of The Journal of Heredity, and would demand more space than the journal could possibly afford it.

My conviction, then, is based upon a somewhat extended observation of government in practice. I have observed the operation of constitutional democracy in England, in Canada, in the United States, in Australia, and in France; of constitutional monarchy of a non-democratic type in Germany; of an almost pure absolutism in the Kingdom of Sarawak, Borneo; of non-parliamentary paternalism in India, in Java, in Burma, in Indo-China, and in the Federated Malay States; of parliamentary paternalism in the Straits Settlements, in Barbados, in British Guiana, and in Hong Kong.

So confused is the terminology of government that no standard definition of terms is available. I have adopted the foregoing classification simply for the purpose of making clear a distinction which is, I believe, vital to an understanding of any question connected with comparative government.

So far as my observation goes, England, Canada, the United States, Australia, and France have, in varying degrees, been less well governed in modern times than the countries which follow them in the list. The reason for this is, in my judgment, very clear, namely, that in the former group local politics have cast a blight upon the administrative functions of government, whilst in the latter group almost all administrative projects have been conceived and carried out, chiefly by experts, on the basis of their intrinsic merits. In other words, in the latter group of countries the health, comfort, convenience, and prosperity of the people have not been the pawns in that political game so wittily described by Mr. Balfour as "a system of organized quarrelling."

A word of explanation is necessary in regard to Germany. Until 1914 we heard little but praise of Germany's internal administration. As Professor Cook and Mr. Robert Carter Cook say in their reply to me: "German cities were cleaner than English or American cities. The visitor to Germany did not see the docks of Hamburg lined with human scarecrows, or little children going barefoot in the snow, as in the streets of Liverpool. Disheveled slums like those of New York or London did not exist. There were no hungry beggars or aimless people wandering in rags. Irresponsible indigence was as strictly forbidden as other misdemeanors."

Now it was surely not any of these things which led Germany to adopt her foreign policy of violent aggression or to carry it out with such infamous barbarity. To attribute her conduct to such causes would be to declare that clean, healthy, well-educated, and industrious people are more affected than others toward lust and violence. It was because German *Administration* was controlled by a special class that it was so excellent; it was because her *Policy* was controlled by a special class that it was so pernicious.

The distinction between policy and administration, as the two elements in government, is seldom drawn by writers on politics; yet it is, in fact, mainly upon the drawing of this distinction that good government depends.

The comparative inefficiency of government in democratic countries is due in a large measure to the circumstance that a single method, that of the ballot-box, is employed to achieve two wholly different aims—the ascertainment of the popular will, and its execution.

So long as the task of government was little more than to build the post-roads, impound stray cattle, punish a few criminals and misdemeanants, and collect a few taxes, it was easy to discern the popular will; and to execute it required little more than common sense.

Today, however, there is practically nothing which is not the concern of government; and in relation to the vast majority of administrative problems the public is not only absolutely incompetent to form an opinion, but is almost equally incompetent to select someone who is competent to form one. Assuming, however, that there is an informed majority opinion in regard to any question of domestic policy; and assuming further—what is a very wild assumption—that this opinion upon this question is reflected at the polls; we still have to face the fact that the carrying out of the public will today is for the most part a matter of extremely technical knowledge, a matter of chemistry, of engineering, of bacteriology, of electricity, of preventive medicine, and of other highly specialized sciences.

It is this shift in the center of gravity of government which has escaped the notice of those who approach the question of politics as though patriotism and democracy were still chiefly concerned in emancipating the people from the tyranny of a king, and who seem to believe that the people will always be content to accept an impotent political freedom as a substitute for efficient administration.

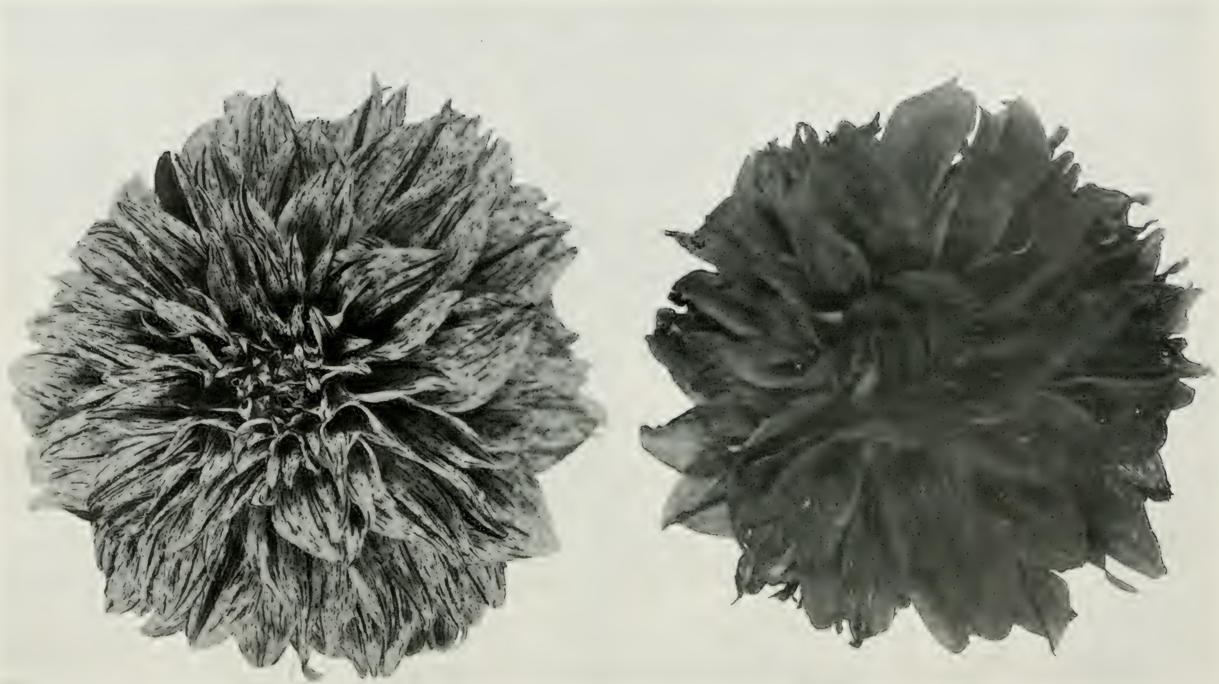
A BUD VARIATION OF THE LE GRANDE MANITOU DAHLIA

A. D. Shamel

In The Journal of Heredity for December, 1918, the writer described a striking bud variation in a dahlia plant found in a garden at Riverside, Cal. Since that time he has been on the lookout for similar instances of dahlia bud sports. In September the dahlias of southern California are in full bloom. While visiting a citrus ranch at Alta Loma on September 9, 1919, my attention was called by the manager, Mr. W. M. Mertz, to a very interesting case of bud variation in the well-known dahlia variety Le Grande Manitou. The two plants of this variety are growing in the dooryard of the manager's house and are in fine physical condition. The typical flowers have a white ground and are striped and speckled with violet. The flower on the left in Fig. 10 is a representative bloom of the Le Grande Manitou from these plants.

The two Le Grande Manitou plants both produce, in addition to the typical flowers, blooms having solid violet color as shown in the flower on the right in Fig. 10. At the time of our examination of these plants one violet bloom was found on each plant to about twelve of the typical flowers of the variety. Mr. Mertz told the writer that up to this time each plant had produced several violet blooms.

As can be seen in the illustration, the two flowers, borne by the same plant, vary in other characteristics than that of color. The number, shape, arrangement and size of petals are decidedly different in the two blooms.



LE GRANDE MANITOU DAHLIA

The typical Le Grande Manitou flower is here shown on the left. On the right is a bud variation from the same plant. This is one of the striking cases of bud sports in dahlia plants and illustrates the origin of new varieties from bud variations. (Fig. 10.)

DEFICIENCY IN INTELLECT FOUND TO BE CORRELATED WITH DEFICIENCY IN THE NUMBER OF BRAIN CELLS

PATHOLOGISTS have known for some time that imbecility depends in part at least upon a deficiency in the actual number of cells of the higher cerebral regions. Hammarberg in 1895 showed by actual counting that such is the case. This theory is supplemented and supported by some recent work on the lesser-brain.

"In the spring of 1916, while examining the cerebellum of a general paralytic, the writer[1] was first impressed by the fact, familiar perhaps to most neuropathologists, that in this disease there is often a disintegration and disappearance of a large number of the Purkinje cells, leaving, however, the basket of fibers which normally surrounds them. Over a year later, while examining the cerebellum of a microcephalic idiot, the same scarcity of Purkinje cells was observed, with the difference, however, that the section did not show the same evidence of the cells having become reduced in number by disintegration; the empty pericellular baskets were not found as in the case of paresis; it seemed, rather, that through some defect of development the normal number had never been present.

"In order to get a fair basis for comparison, a number of cerebella were studied and the relative frequencies of cells noted. In some of the cases the cells appeared to be almost uniformly distributed and with few large spaces between them; others showed losses similar to the two cases already mentioned.

"Among the cerebella examined was one of a man who had died at about the age of sixty-five years after a protracted illness, and this, too, showed a distinct loss of cells. So from this preliminary set of observations it seemed clear that the number of Purkinje cells is variable under different conditions.

"It is well known that in paresis, in extreme old age, and in low grades of feeble-mindedness there is ordinarily a considerable degree of deficiency in motor coördination. The question consequently arose, how far is it possible to find differences in the number of cells that will account, partially at least, for the observed differences in behavior?

"The writer's primary interest at the time of taking up this investigation lay in the question of the anatomical basis of mental defect, and it seemed not improbable that a careful study of the Purkinje cells might throw some light on one of the most evident deficiencies found in such cases. The human motor mechanism is much more highly developed than that of lower forms, especially with reference to speech, hand movement, and the maintenance of equilibrium while standing or walking. Mental defectives generally show less motor control along these lines, and it is desirable that we know as far as possible the neural basis for such lack of coördination. A further reason for making a study of the cerebellum in such cases is found in the fact that a number of writers, especially Tredgold ('03) and Bolton ('03, '10) in England, have emphasized, perhaps unduly, the importance of the frontal lobe of the cerebral cortex as the area particularly affected in amentia. It accordingly seemed worth while to determine whether the brains of aments show defects in other parts, such as the cerebellum, which is not generally associated with intelligent reactions as such."

Dr. Ellis at the close of his article comes to the conclusion that in low grade mental defectives there is a distinct deficiency either numerically or cytologically in a large percentage of the Purkinje cells. He does not go into the question of heredity, but he does contend that practically all the cases are due to some form of antenatal degeneration.

[1] Robert S. Ellis: "A preliminary quantitative study of the Purkinje cells in normal, subnormal and senescent human cerebella, with some notes on functional localization. *The Journal of Comparative Neurology*, vol. 30, No. 2, February 15, 1919.

FIRST "BAD HABIT"—SUCKING ITS THUMB

Fig. 11.

David Fairchild

HOW is it to be explained that these babies, when still too young to imitate what is going on around them and without being taught, acquire what many doctors and dentists declare to be a very bad habit? Baby mud-wasps which hatch after their mothers and fathers are dead know how to build their complicated mud nests without being taught. Are we sure that this human habit of thumb-sucking, which has appeared successively generation after generation in very young babies, is not of a similar instinctive or hereditary character?

If it is hereditary, is it beyond question injurious, and does it certainly produce protruding teeth and flattened thumbs, and does it arch the roof of the mouth, or are these changes merely coincidental with the habit? Are we confident that by employing forcible means to cure the habit we do not run the risk of affecting the child's emotional or moral nature—of making it secretive or even untruthful? Should not the habit be cured by the ridicule of a child's peers on the playground—by its own self-control?

If this habit is hereditary, are not others of the same nature, and should we not, in our discipline of children, differentiate between the habits of imitation and those which are inherited?

According to Dr. Alexander Graham Bell:

> The mere act of suction could produce no such effect as the protrusion of the teeth. On the contrary, with a partial vacuum in the mouth the atmospheric pressure from outside would tend to push the teeth *in*, not out. Theory would indicate that the act of suction should actually be beneficial to the plastic growing mouth by bringing atmospheric pressure into play from outside, tending to consolidate the mouth and oppose any tendency to the spreading of the parts.
>
> Any spreading action could only be due to pressure applied from within. A child for example might press his tongue against the roof of the mouth or against the back of the front teeth and thus produce a pressure which if constantly applied would gradually result in a spreading action, but there is no evidence that a child ever does this.

Again it is conceivable that a child in the intervals between suction might press his thumb against the back of the front teeth but here again there is no evidence of active muscular effort. On the contrary the intervals between the acts of suction are characterized by relaxation of the whole muscular system, the child tending to fall asleep and the thumb tending to fall out of the mouth.

Sucking the thumb is such an instinctive action with very young children that it is probable that most babies, if not all, indulge in the habit during the first year of life. Some people have protruding teeth in adult life and if you examine their past history it is probable that most of them sucked their thumbs in infancy. Hence we are apt to jump to the conclusion that the sucking of the thumb was the cause of the protrusion of the teeth, in spite of the fact that will be at once perceived by those who know anything about atmospheric pressure that the act of suction could not possibly produce any such effect.

The idea that suction could produce a spreading action in the mouth is as ridiculous as the very common notion that sucking the thumb causes a child to become cross-eyed!

The importance of being able to make or break a habit at will was so drilled into me by one of my great friends that it has come to seem to me one of the greatest things in life. When the first baby came I determined that he should have a fair start. He should not be allowed to form any undesirable habit. Almost immediately, or certainly when he was only a week or two old, he got his thumb into his mouth. Everybody admitted that this was the beginning of a bad habit. Some predicted that he would make his front teeth protrude and spoil the shape of his mouth, others knew he would ruin the looks of his thumb, and others said that thumb-sucking was connected with internal disorders of a serious character.

With the impression firmly implanted in our minds that the forming of a bad habit was the worst thing that could happen to a baby, we began to try to cure this one of sucking his thumb. We tried cassia solution, but he enjoyed the bitter taste. We put tiny mittens on his hands, and he either sucked them until they were wet through or pulled them off. We tied his arms, but he always struggled loose. We bought those round aluminum hand balls which are supposed to be a real cure, but he bumped his head with them and got into almost hysterical fits of temper.

The weeks stretched into months and we did not give up the fight. As the months became years we tried bribery and corruption. We threatened and we punished. When the second child came she followed in her brother's footsteps, with variations, and when the third baby arrived she embroidered the thumb-sucking habit by twisting her night dress or sheet around her third finger. By this time we began to realize that we were confronted by something which was not so simple as one of the habits of later life, and we finally gave up. There seemed to be something almost instinctive in the way this habit resisted our treatment, and we began to suspect a hereditary character in it.

Among some old photographs of the children's mother (perhaps luckily for the father none of his own baby photographs were on hand) we came across one in which she was shown sucking her thumb. By a curious coincidence we had had one taken of our eldest child at about the same age and in the same attitude without knowing of the existence of the mother's photograph. And while we were discussing this, it came up in conversation that the mother's mother had also sucked her thumb, and later the daguerreotype evidence of this was found.[1]

The evidence seems strong to his parents that it was natural for the boy to suck his thumb and did not come from sheer wilfulness on his part.

If this is indeed an inherited instinct and not a personally acquired habit, the breaking of it may be a long and difficult task, and we should be very sure that it is indeed injurious before we waste our time and worry our poor little babies trying to do so.

What a weight would be lifted from the shoulders of thousands of young parents could they with clear consciences let their babies suck their thumbs in peace!

[1] The photographs here published, with the permission of all three babies, it is understood, are of Mabel G. Hubbard (Mrs. Alexander Graham Bell), Marian Hubbard Bell (Mrs. David Fairchild), and Graham Bell Fairchild. Each of these three babies has its right thumb in its mouth.

AN EARLY FAMILY HISTORY OF COLOR BLINDNESS

Illustrating the Rule That Sons Can Inherit Normal Color Vision Only from Their Mothers, While Daughters May Inherit It from Either Parent or Both

LEON J. COLE

Professor of Genetics, University of Wisconsin

IN THE Philosophical Transactions of the Royal Society of London for 1779 is recorded a rather complete family history of color blindness, to which, so far as I am aware, attention has not been called in recent studies on the subject. It consists of a letter from one J. Scott, describing his own condition and that of his near relatives, which was communicated to the Society by the Rev. Michael Lort.[2] It is of interest because of its early date and because the facts as given fall so perfectly into line with the interpretation of color blindness as a sex-linked character in man.

In describing the imperfection in his own sight Mr. Scott states that he does "not know any green in the world." Pink and pale blue appeared alike; full red and full green the same. He could tell yellows and all degrees of blue except very pale. He was sometimes baffled by full purple and deep blue. In this connection he cites an incident which is so quaint and full of human interest that it may be quoted verbatim. He relates:

"I married my daughter to a genteel, worthy man a few years ago; the day before the marriage he came to my house, dressed in a new suit of fine cloth clothes. I was much disappointed that he should come (as I supposed) in black: said, He should go back to change his colour. But my daughter said, No, no; the colour is very genteel; that it was my eyes that deceived me. He was a gentleman of the law, in a fine rich claret-coloured dress, which is as much a black to my eyes as any black that ever was dyed."

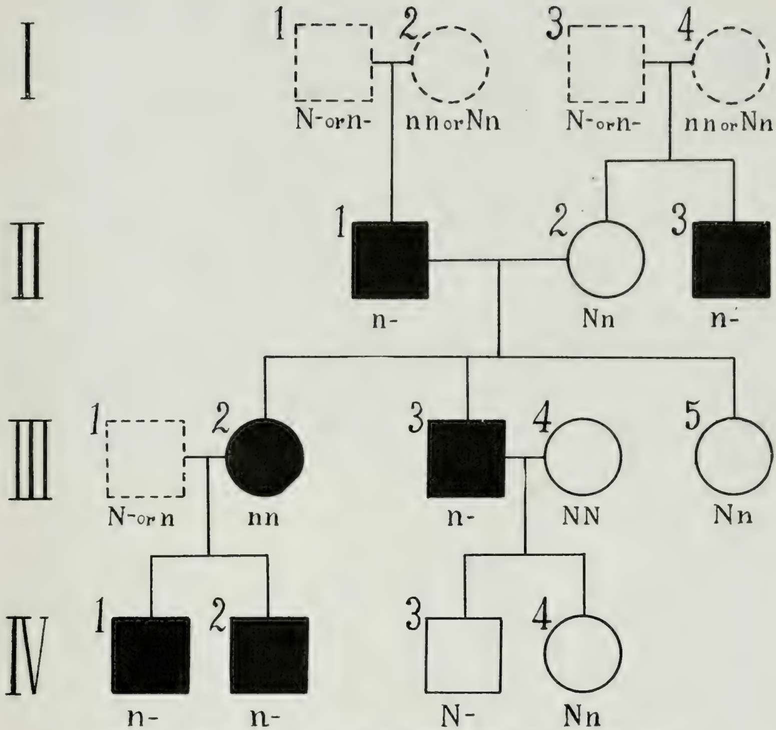
The accompanying diagram is constructed from the data supplied by Mr. Scott on the occurrence of color blindness in his family. In the following quotation the numbers inserted in brackets show the position of the individual referred to in the diagram. To use then his own words:

"It is a family failing: my father [II 1] has exactly the same impediment: my mother [II 2] and one of my sisters [III 5] were perfect in all colours: my other sister [III 2] and myself [III 3] alike imperfect: my last mentioned sister has two sons [IV 1, 2] both imperfect: I have a son [IV 3] and daughter [IV 4], who both know all colours without exception; and so did their mother [III 4]: my mother's own brother [II 3] had the like impediment with me, though my mother, as mentioned above, knew all colours very well."

Using the symbol N for normal vision and n for its allelomorph, and also assuming that N is sex-linked, we may have the following genotypes: NN, homozygous normal female; Nn, heterozygous normal female; nn, color blind female; N—, normal male; n—, color blind male. It is then possible, on the basis of the data given, to designate the genotypes of all the individuals men-

[1]Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 17. Published with the approval of the Director of the Station.

[2]Lort, Michael. An account of a remarkable imperfection of sight. In a letter from J. Scott to the Rev. Mr. Whiffon, of Trinity College, Cambridge. Communicated by the Rev Michael Lort, B.D., F.R.S. Philos. Trans. Roy. Soc. Lond., Vol. 68, Part 2, pp. 611-614. 1779.



THE OCCURRENCE OF COLOR BLINDNESS IN ONE FAMILY

The above diagram illustrates the history of color-blindness as it occurred in three successive generations. The father was color blind, and the impediment was inherited by his son and one daughter. The mother and one daughter had perfect eye-sight. The daughter who was color blind had two sons, both with imperfect eyesight. The son also had two children, a boy and a girl, who both, like their mother, had normal color vision. (Fig. 12.)

tioned. For the males this is of course simple, since it may be known from the phenotype, all normal males (IV 3) being *N*— and the color blind ones *n*—(II 1, 3; III 3; IV 1, 2). In the case of the normal females, on the other hand, the genotype must be ascertained from the known kin. The subject's mother (II 2), for example, was normal, but since she had both a color blind son and daughter she must have been *Nn*, that is, a "carrier" of color blindness; the son must have inherited the color blindness from his mother, since it is transmitted only in that way, and a daughter can be color blind only when she inherits it from both parents. The other daughter (III 5) was normal, but must have been heterozygous (*Nn*) because of her father being color blind. The same rule applies to the subject's own daughter (IV 4). The only other woman described is the subject's wife (III 4), who had normal vision, and who probably was homozygous (*NN*), for had she been heterozygous the chances would have been even for either the son or the daughter to be

color blind, and considerably less than even that they would both be normal.

As to the conditions of the subject's grandparents (I 1 and 2, 3 and 4), which are not stated, it is possible only to conjecture, though it is apparent that both the grandmothers must have been either color blind or heterozygous for the defect. The grandfathers might have been color blind or not as far as the data go. Nothing further can be said about the paternal grandparents, but the subject's mother having had normal vision it is possible to say that if his maternal grandmother (I 4) was color blind her husband must have had normal vision, whereas if she had normal vision he must have been color blind. That is, to give the results obtained (heterozygous normal daughter and color blind son) the mating must have been N— × *nn* or *n*— × *Nn*.

It would have been interesting if he had noted the condition of his brother-in-law (III 1), that is, the husband of his color-blind sister (III 2). It was a foregone conclusion that all her sons would have defective vision since she herself was color blind, but any daughters would have served as an index to the father's condition, since their vision would have corresponded to his. As it is, he may or may not have been color blind.

THE GESTATION OF THE CARABAO

B. M. Gonzalez,
Associate Professor of Animal Husbandry, College of Agriculture, University of the Philippines.

LITTLE is known about the breeding habits of the carabao (*Bos bubalus*), since these animals are on the range most of the time. They rarely go under shelter except during the busy season of harvesting, when they are tied close to the house of the farmer, under a light bamboo and cogon or nipa shed, and are fed on sugar-cane leaves or rice straw. While the crops are growing, the carabaos are used in cultivating the crops, and are grazed on vacant lots, on paths overgrown with grass, or on the roadside. At these times breeding is not likely to occur, as these animals are herded more or less individually by the children of the farmers.

After harvest, all the carabaos in the neighborhood have the run of all the fields in common, since fenced areas are rather rare in the Philippines, and it may be presumed that it is at this period when breeding occurs. Carabaos mature later than cattle, bulls hardly breeding regularly before three years of age, and cows usually bringing their first young at five, sometimes at four, but rarely before that. Under such conditions it is impossible to determine the exact gestation of the carabao, and an inquiry among the farmers elicits a variety of answers ranging from nine to thirteen months or more.

With the acquisition of a small herd of these animals by the College of Agriculture, the cows were kept separate from the bull from the start, and observations were made on their estrum. The period of estrum of these animals is very obscure, and the only way we succeeded in breeding them was by attempted matings of them at frequent intervals.

The figures obtained so far, while few, are significant, inasmuch as they are fairly uniform. Due to the reasons mentioned above, observations on the period of gestation of this animal will probably never become numerous. At the College we estimate that we lost about half a year on an average for each cow observed by not knowing the exact time when each cow should be bred, due to the obscurity of estrum.

CARABAO COW WITH THREE DAYS OLD CALF. (Fig. 13.)

The Philippine carabao is essentially the same as the buffalo or water buffalo of India, China, Java, and other oriental countries, except for slight variety differences as to size and shape of horn, color and texture of skin, and slight differences in conformation. The writer examined the literature from the above countries but has not come across any observations pertaining to this question.

The animals observed so far are as follows:

The gestation of the carabao, therefore, is approximately 320 days, or forty days more than the cow (280),

Animal.	Date bred.	Date calved.	Sex of calf.	Period of gestation
Cow No. 1	June 24, 1918	May 14, 1919	Female	324 days.
Cow No. 2	Jan. 5, 1918	Nov. 19, 1918	Female	318 days.
Cow No. 4	Jan. 6, 8, 10, 1918	Nov. 30, 1918	Male	324–328 days.

and twenty days less than the mare (340).

Observations were also made on the period of estrum immediately following parturition, and this gave us:

This period was determined by trying, every two days after calving, to mate the animals. These latter figures are simply offered as observations and may not hold true in every instance.

Animal	Date of calving	Date of first estrum	Lapse of time after calving
Cow No. 2	November 19, 1918	Jan. 12, 1919	54 days
Cow No. 4	November 30, 1918	Jan. 23, 1919	54 days

A REMARKABLE BUD SPORT OF PANDANUS[1]

John H. Schaffner

A SMALL specimen of Pandanus, planted in a flower pot, had been carrying on a precarious existance for many years in the botanical greenhouse of the Ohio State University, when in the fall of 1916 it was transplanted into a bed of rich earth in the aquatic room. This screw-palm apparently belongs to the species *Pandanus utilis Bory*. The genera of Pandanaceae—Freycinetia, Sararanga, and Pandanus—are all described as having spirally arranged leaves and apparently all have three spirals. It is not certain, however, from the descriptions at hand, whether or not all the species have the three spirals.

The plant under consideration had the normal three spirals of leaves characteristic of the species and continued this character for awhile after being transplanted; but the leaves immediately began to grow larger and longer, probably due entirely to the improved soil and water conditions. Soon, however, the terminal growing bud underwent a remarkable transformation and sported in such an extreme manner that the plant has assumed an entirely new aspect. The mutation resulted in a two-ranked arrangement of the leaves in which the spiral twist is entirely absent (see Fig. 14). After growing for some time, the plant took on the aspect of a great fan, putting one in mind of a traveler's tree, *Ravenala madagascariensis*. The last three leaves before the change were each about 2 feet 1 inch long and quite rigid. The first two leaves of the two-ranked portion were also 2 feet 1 inch long and rigid, but in the subsequent stages the leaves continued to become longer and very flexible and recurved. The eighth and ninth leaves were each 4 feet 3 inches long, while the latest leaves produced measure 5 feet 3 inches in length.

The families, Sparganiaceae and Typhaceae, are closely related to the Pandanaceae, and in passing up the series to Typha one finds not only a much more specialized type of flower but also the more extreme conditions represented in the herbaceous stem, geophilous habit, two-ranked leaves, and distinct internodes. The leaves of Typha are still somewhat spiral in arrangement, but have the prominent sheath characteristic of many of the highly evolved monocotyls.

The Pandanales are probably more closely related to the lower palms than to any other group of plants, and the palms approach such lower lily types as Yucca and Cordyline. Among the lilies and their relatives the change from three to two spirals or to the two-ranked condition is frequent, and takes place even at the lower levels of the evolutionary series.

The palms are well known as mostly trees with unbranched trunks and three spirals of specialized leaves. Assuming such an origin for the Pandanales, the phyletic arrangement of the three related genera is as follows: Pandanus, Sparganium, Typha. We have, then, the following progressive series:

1. From tree to geophilous, rhizome herb.
2. From three spiral leaves to two-ranked condition with the spiral more or less obliterated.
3. From no internodes to well-developed internodes.
4. From fleshy drupes to minute, dry, nut-like fruits.

[1] Papers from the Department of Botany, the Ohio State University, No. 113.

LEAVES OF PANDANUS

This unusual specimen of Pandanus originally had the three spiral leaves characteristic of its species, but after being transplanted from a flower pot into a bed of rich earth, transformed its leaves into two ranks with the spiral twist entirely absent. The leaves which were at first 2 feet 1 inch long and quite rigid grew to a length of 5 feet 3 inches and became very flexible (Fig. 14.)

The present bud sport of Pandanus utilis has therefore made two fundamental progressive changes at one mutation. It has lost one spiral of leaves and also has changed the positions of the two remaining ranks in such a manner that the spiral or twist is entirely obliterated. The cause for those peculiarities must be in some changes in the nature of the hereditary apparatus, presumably the chromosomes, but whatever the cause, it is of the same nature as that which must have occurred a great number of times either in the vegetative tissues or in the reproductive cells of numerous independent series of Monocotyls. In some groups one of these characters has been acquired independently. In those cases where a species has advanced to the two-ranked condition without a spiral twist there may have been but one mutation, as the bud-sport in hand, or there may have been two or more successive mutations to bring about the final form.

Beyond the Veil

Modern Psychical Phenomena, by Hereward Carrington, Ph.D. Pp. 331, illustrated, price $2.50. New York: Dodd, Mead & Co., 1919.

Psychical research is becoming ambitious. Not content with lifting the veil that conceals the future, it will now raise the veil from the past. Thus Dr. Carrington not only elucidates the nature of sex and bisexual reproduction in the spirit world of after-death, but illuminates the origin of natural selection.

Life appeared on this planet when the conditions "were favorable to the formation and continuance of life." So far, so good. "So long as these conditions lasted, life prospered; everything favored its growth. This first living matter grew and finally split up, or in some manner gave birth to other living matter, and the procession of life had begun." Simple, like all other great discoveries.

"But mark this—death had not yet appeared upon the earth; sickness and decay had not yet made their presence felt—for if they had, at the very origin of creation, life would have become extinct as soon as it came into being." The argument is at least plausible.

"So long as life went on in an uninterrupted and peaceful manner, just so long was 'everything in the garden lovely.' Life increased and multiplied, and nothing had come to destroy it. But one fine day the living substance reacted wrongly—contrary to the laws governing its environment, and then the external forces of nature burst forth, swept down and destroyed a portion of this living substance, and injured another portion, causing it to become 'diseased' and decay. The uninjured portion continued to live and propagate; the injured portions died." *"Disobedience to cosmic law* thus constituted the first evil—*protoplasmic disobedience*—the penalties for which were disease and death."

Aside from such evolutionary revelations, Dr. Harrington's book contains a readable account of the status of psychical research as viewed by one whom the professional researchers regard as an authority. He considers "hypnotism, dreams, telepathy, crystal gazing, automatic writing, the vast powers of the subconscious mind, dissociation of personality, multiple personality, and many other phenomena today recognized and accepted by 'orthodox' science," and believes that "many other phenomena (such as apparitions, 'ghosts,' haunted houses, telekinesis, materialization, thought photography—even spirit communication itself) are today gradually but surely winning acceptance." His ideas of the valuation of evidence may be measured by his discovery of "a mathematical proof of the existence of a spirit world" in the fact that mathematicians find "imaginary quantities" convenient in their notation.

THE RELATION OF HEREDITARY EYE DEFECTS TO GENETICS AND EUGENICS[1]

LUCIEN HOWE, M.D., *Buffalo*

OF LATE years, while trying to learn something about ocular muscles, I have been confronted often by questions concerning heredity. I have found, as others doubtless have, three, four or even more persons in the same family with a similar form of heterophoria,[2] heterotropia,[3] predisposition to ocular fatigue, or similar abnormal muscular conditions. It seemed impossible to study these anomalies satisfactorily without first halting to learn something about that mystery which we call heredity.

It is not possible here to give any systematic account of the studies already made of hereditary eye defects, except to mention the classic work by Groenouw,[4] the interesting histories collected by Nettleship, the more recent bibliography by Loeb, with the exhaustive articles by him, or those by Libby and others. The point is that we ophthalmologists have been content thus far with reporting family histories without attempting to relate those histories to other facts, now well established by geneticists.

The best way to learn these principles, and one vastly more interesting, is to supplement the reading with at least a few experiments.

The breeding of eye defects is easier than most persons imagine. Chickens and pigeons are the best subjects for such experiments.

By advertising in the *Reliable Poultry Journal* and other trade papers, it has been possible to obtain for the parent stock more than a dozen specimens of eye defects. These included corneal irregularities, and variations in the color of the iris and in the position of the eyes and of the pupil. The different pens of chickens at a small place, known as Mendel Farm, on the lake shore near Buffalo, have proved to me a source of much interest and enlightenment.

The breeding of dogs has not been found satisfactory. Eye defects are rare, the generations slow and the litters small. For similar reasons, cats are undesirable. It is probable, however, that interesting results could be obtained by breeding white cats which have blue eyes—such cats being often deaf. This fact had been already observed by Darwin and has been the subject of breeding experiments by Dr. Graham Bell.[5]

The eyes of the small fruit fly, *Drosophila ampelophila*, have proved most interesting. I am indebted to Professor Morgan of Columbia for parent stock, the blind variety of which I bred through more than twelve generations.

PRACTICAL VALUE OF THE STUDY

The average reader of this paper may say that such a glance at the principles of heredity may be curious and possibly interesting, but of what practical use is it?

Of course we never find a typical Mendelian ratio in the human species, because brothers and sisters never

[1] Read before the Section on Ophthalmology at the Sixty-Ninth Annual Session of the American Medical Association, Chicago, June, 1918. Reprinted in condensed form from the *Journal of the American Medical Association*, Vol. 70, pp. 1994–1997.

[2] A tendency of the visual axes to fail to meet in the fixation point, due to weakness of one or more of the ocular muscles or their faulty innervation.

[3] Displacements in position.

[4] Groenouw, in Handbuch der gesamten Augenheilkunde, Graefe-Saemisch, Ed. 2, Part 1, Vol. 11, p. 415.

[5] Bell, Alexander Graham: Tr. Otol. Soc., 1885, Vol. 3, p. 478.

marry.[6] But an approach to these ratios we do find constantly, and that law furnishes an important guide, not only in recognizing heredity itself in a given family history, as distinguished from an infection, but in also indicating when the defect is dominant or recessive. In other words, this relation between genetics and ophthalmology throws light on the differential diagnosis (the next step in our study), and is very decidedly practical in connection with eugenics.

With this reassurance as to the reason for continuing, let us pass to the examination of family histories to determine whether a given defect is in reality hereditary, or whether it is due to infection from syphilis or other causes.

It would necessitate a rather long digression to show just how this differential diagnosis is made. Suffice it to say that our criterion is the technical definition of heredity given at the outset. The fact is that a very considerable proportion of defects which we all supposed formerly were hereditary are probably not hereditary, but the effect of some infection more or less obscure. An excellent example of this is a family history of aniridia reported by one of the oldest and best known members[7] of this section. The author and all other ophthalmologists accepted this as an undoubted example of heredity, but competent geneticists now demonstrate that to be highly improbable.

The term "hereditary" we should also define more exactly as including two groups—one in which the recurrence of the defect is only "possible," especially when that defect is "recessive," the other in which its recurrence is "probable," especially when that defect is "dominant." Evidently, therefore, we have as many conditions to deal with as there are combinations, in pairs, of these four factors.

Still another factor enters into the problem—the personal equation of the parties to a marriage contract. For when two persons contemplate matrimony, it can usually be taken for granted that their judgment has, for the time, taken wings. Professor McCready, in his lectures at the College of Physicians and Surgeons, used to say his case records showed that for various reasons he had advised one or both parties against marriage some sixty-eight times; and his records also showed that sixty-eight times the couples went almost straight to the altar.

But temporary obsessions by those who ask an opinion is no excuse for inability to advise intelligently, or, if necessary, to restrain persons from a fatal mistake. Therefore the other four factors in our problem demand all the more careful study. While the difference between a simple deformity and blindness is evident, it is not easy to say whether the recurrence of a given defect is "possible" or "probable." Our decision, then, must be based on three groups of data: first, whether the defect is inherited as a dominant or a recessive; second, whether it is a sex-linked characteristic, and, third, whether both families show the defect.

A few illustrations will show how these four cardinal conditions in our problem may serve as the basis for an opinion by an ophthalmologist when he is called on to give advice in the case of a proposed marriage. Thus:

(*a*) When we have to do only with a deformity, and its reappearance is doubtful, no special objection need be raised.

(*b*) When we have to do only with a deformity, and its reappearance is probable, the parties to the marriage should both be warned of the probability of the reappearance of that defect in their offspring.

(*c*) When we have to do with blindness, and its reappearance is doubtful, a stricter attitude toward the union can be assumed.

(*d*) When we have to do with blindness, and its reappearance is probable, the question assumes its most serious aspect. If the family history shows

[6] Risley, S. D.: Hereditary Aniridia, *The Journal Amer. Med. Assn.*, April 17, 1915, p. 1310.

[7] Matings between brothers and sisters are not essential to the formation of Mendelian ratios. Ed.

that this defect is in reality dominant, then half the children on the average will develop the defect; or even if the defect is recessive, but occurs in both families, the danger is practically the same.

Another phase of the same problem is presented when a couple is already married, and with little or no history on either side of eye defect; yet in spite of that, for reasons which we do not know, one child after another, blind or partly blind, is born to these parents. This congenital blindness is in one way quite different genetically from hereditary blindness, but from the standpoint of eugenics, families with hereditary and with congenital blindness may be considered together as one group and classed as hereditary. It is desirable to appreciate how important this group is, but space permits here only the categorical statement of a few facts, which, properly presented, would fill a small volume. These facts are:

(*a*) The number of this group in the United States is considerable. It has been estimated at about 8,000 and upward. According to the census of 1910, the total number of blind was 52,272. Counting unavoidable and admitted errors in that census, the results of subsequent surveys, and increase of population, the National Committee for the Prevention of Blindness estimated the number of blind in 1917 at from 100,000 to 110,000. According to the data given by Best in his exhaustive and recent study of the blind in this country, the proportion of hereditary and congenital blind is considerably larger than here stated. But in giving estimates, the minimum limit is evidently the safest.

(*b*) The cost also is considerable. According to statistics carefully collected in Massachusetts and elsewhere, the average cost per year of each blind person in and out of institutions is at least $475. This gives us a total annual cost of some $3,800,000.

(*c*) It is unjust to the blind to allow them to be brought into existence simply to lead miserable lives.

(*d*) It is unjust to taxpayers to be compelled to support them.

(*e*) The longer we delay action to prevent this blindness, the more difficult the problem becomes.

(*f*) A large part, if not all, of this misery and expense could be gradually eradicated by sequestration or by sterilization, if the transmitter of the defect preferred the latter. An idea of this plan is given by the somewhat similar one for dealing with feeblemindedness. In 1913, laws for sterilization, under certain circumstances, had been passed in twelve states and proposed in nine others. Bulletin 10 of the Eugenics Record Office, Cold Spring Harbor, L. I., N. Y., gives a map showing the status at that time of such legislation. Where such eugenic laws have been enacted or favorably considered, probably existing laws could be properly amended or new laws passed to prevent this form of blindness. The same bulletin gives the form of a model law for this purpose. It was prepared by committees composed of the most eminent physicians, surgeons, sociologists, students of genetics and similar experts in this country. That law could be made applicable to the prevention of hereditary blindness, but with an important difference, which makes the prevention of this form of blindness comparatively easy and inexpensive. No legal action is essential until after a marriage has been found to produce blind children, and even then sequestration of the transmitter of the defect may be substituted for sterilization. Moreover, if this sequestration is of a kindly nature, with congenial occupations suited to the intelligence and social tastes of the subject, the sense of restraint is slight, since it is reduced to the minimum. This is not theory but experience, as shown especially by the colonies for the feebleminded established by Dr. Charles Bernstein of the State Custodial Asylum at Rome, N. Y.

WHAT ARE WE GOING TO DO ABOUT IT?

In other words, we have all this misery and expense, both of which are largely unnecessary; we have also an effective method of relief prepared by committees of our foremost experts and already well supported, in principle, by

public opinion. What are we going to do about it? That is the question at last forced on ophthalmologists—especially on the Section on Ophthalmology of the American Medical Association. Shall we complacently continue to do nothing, thus retarding social advancement and even ophthalmology itself? The answer to this question involves many details, both of principle and of method, far too complicated for discussion now. But in executive session a motion will be made for the appointment of a committee to report on this subject another year.[9] If at that time or later, some plan can be formulated for the prevention of this form of blindness, it will perhaps seem worth while for us to have directed our attention now, even in this hasty manner, to the relation of hereditary eye defects to genetics and eugenics.

A STRAIN PRODUCING MULTIPLE BIRTHS

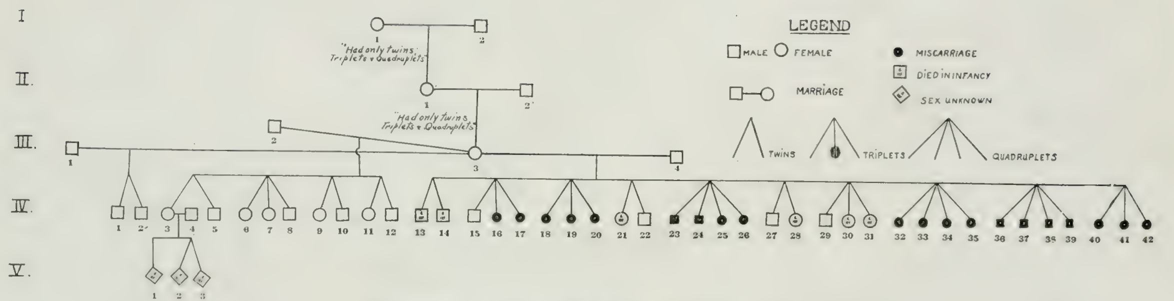
C. B. Davenport, *Cold Spring Harbor, L. I.*

AMONG the findings of the Eugenics Record Office has been that of a family in Cleveland (Mrs. W. G. C.) which has a remarkable record in the production of two or more children at a birth. The history has a special interest owing to the fact that the present Mrs. C. has married three times. There is no information at present available concerning the tendency toward multiple births in the families of the husbands, but, in view of the fact that multiple births are relatively rare, it is exceedingly improbable that all three husbands belong to families having such tendencies. The propositus (Mrs. C.) has been interviewed at different times by three representatives of the Eugenics Record Office. To each the history given has differed in some details. The last of the field workers who visited the woman secured the facts concerning her first husband and her children by him which had remained unknown to the other field workers, and were indeed divulged only after five visits had been made by the last field worker. Further studies are being made upon the family, but it seems probable that the facts are now so nearly ascertained as to warrant a description of it.

The details of the family are set forth in the accompanying figure (Fig. 15), which is a pedigree chart for five generations. The propositus is No. 3 of the third generation, III 3. Her mother and her mother's mother are said by the propositus to have had only twins, triplets, and quadruplets. It must be said in all candor that the propositus, although willing to coöperate, has certain mental limitations which make it necessary to check all her statements from independent sources, and this has not been possible in the case of the statement concerning her mother and mother's mother, as the propositus was born in Paris and her parents and grandparents never came to America.

The propositus married first husband No. 1, and by him had twins (IV 1, 2) but her husband, Mr. M., died fourteen months after their marriage. Two years after her first marriage, the propositus married T. R., who was a French Canadian, and who died in 1896. By him the propositus had first children, twins, Violet and Clay. This Violet married a Mr. N., and had a single child, and two years later twins, who with the mother died shortly after birth. The next children of the propositus were triplets, named Esther, Flossie and Theodore. These all died

[9] That committee was appointed and we have begun the work.



PEDIGREE CHART FOR FIVE GENERATIONS

The diagram above illustrates a remarkable record of "a woman who, in three successive marriages, has never had a single child at a birth." A history of this case shows that there have been multiple births in each of four successive generations. The propositus who is indicated by No. 3 in the third generation (III-3) was married three times. (Fig. 15.)

young of some intestinal disorder. Two years after (in 1895) there were again born to the propositus twins—Anna, who still survives, and Charles, who died young. The next year another pair of twins were born—Irene, who still survives, and Clarence, who died young. The propositus married, third, W. G. C., in 1902, and he is still living. He is of English and Scotch descent. By him the propositus had first (probably 1903) a pair of twins by the names of Howard (who died at eight months of hydrocephalus and Noah (who died soon after his twin brother). In December, 1904, triplets were born, of whom the eldest, Will, is still living, but of whom the other two were born dead. About a year later the propositus had a miscarriage of triplets (IV 18, 19, 20). In 1907 there were born twins (IV 21, 22); a boy, Hugh, is still living, but the girl died one hour after birth. Then followed the next year a miscarriage of two boys and two girls. This seems to have been brought on by the poor health of the mother. In 1909 there were born twins (IV 27, 28); a boy, Edward, is still living and a girl died at the age of ten days in the hospital. In 1910 triplets were born (IV 29, 30, 31); a boy, Roland, still lives at home, one of the girls died at the age of one week, and the other was a "blue baby" (that is, one in which the foramen ovale failed to close). In 1912 the propositus gave birth to four girls, born at full term in March, and in December of the same year, she had a miscarriage at about five months, associated with a severe burn that she experienced. In April, 1913, the propositus had another miscarriage, at about three months, of females, as indicated on the chart IV 40, 41, 42. Thus the propositus has averaged nearly three children at a birth and has had thirty pregnancies inside of twelve years in the last mating, in addition to the eleven by the two earlier matings.

The foregoing remarkable case is by no means unique, but accords very well with the similar cases that are reported by Gould and Pyle, "Curiosities of Medicine." The present case, however, is of especial interest because of the testimony that the tendency to multiple births has appeared in each of four successive generations. That the tendency to multiple births is hereditary is clearly brought out in the case of sheep in strains which, like that of Dr. Alexander Graham Bell, have been developed in which twins are almost exclusively produced. Even among commercial breeders the existence of such twin-producing strains is well known. The Dorset horned sheep are reputed to show a greater tendency toward twinning than other races of sheep. It is hoped to make further studies upon the case described in this communication.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. X, No. 9 December, 1919

CONTENTS

A year ago the American Genetic Association announced its desire to communicate with twins living in any part of the world. The response has been highly gratifying. Six hundred twins, and parents of twins, have written letters, and approximately 175 photographs were received. This entire number of the JOURNAL is devoted to discussions based on this correspondence.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, DECEMBER 24, 1919.

COULD TWO LIVING BEINGS BE MORE ALIKE?

In height the same, in weight the same, in tastes, in dispositions and in talent the same, these twin brothers have worked together for twenty-five years and have never been separated. Nine persons out of ten cannot tell them apart. What possibilities in the field of education lie in a study of twins like these? How far could they by different environments be forced apart in character? Supposing one grew up in China, speaking only Chinese, the other in Spain, speaking Spanish, would they still look as much alike as they do, and when we came to know them would they seem as much alike? (Frontispiece).

TWINS

Their Importance as Furnishing Evidence of the Limitations of Environment

David Fairchild

IDENTICAL twins are the only human beings in the world who have exactly the same heredity. If we can find out the characteristic ways in which they remain the same throughout life, the qualities and habits and mannerisms which persist unchanged in them both, in spite of their living in entirely different surroundings, we shall know much more than we do at present about what attributes are hereditary and fixed and what are those which we can hope to modify by environment and education.

THE INFLUENCE OF HEREDITY AND ENVIRONMENT

In all our experiments in education and civic improvements and in our dealings with different races we are always hampered by our ignorance of that great unknown quantity, heredity, and its influence on the people with whom we are dealing.

Any exact knowledge we can gain by a study of two identical twins who were separated from each other as babies and brought up in different towns under entirely different circumstances, scarcely knowing each other, will give us a clearer idea than we appear to have now, of what changes in our bodies, and perhaps, too, in some of our mental and moral characters, are clearly due to the things we eat, the exercise we take, the associations we make, and the work we do—to our environment, as it is called—and what changes, or failures to change, can be correctly traced to our very beginnings in that momentous meeting of the two parent cells which began our earthly lives.

WHAT DETERMINES OUR CHARACTERISTICS

It is strange to think of the way our inheritance comes to us, to realize that all we are to inherit from our mother and from her entire family is contained in a single tiny cell, while all that we are to inherit from our father and his family is contained in another tiny cell. When these two cells meet they become one larger cell and form the beginning of a new individual.

It is wonderful and almost passing belief to realize that a single microscopic cell holds so much of our destiny within itself and that it contains the mechanism which will determine the color of our eyes, the shape of our nose, the love of music, the taste for literature, for law or for science, the quickness of temper or sullenness of disposition which will go so far in deciding what our future is to be. All that the generations of ancestors behind us can give us of themselves, they give us through this tiny cell.

This cell grows and divides into two cells; each of these grows and divides into two more cells, and so the process goes on, controlled by the mechanism contained in the original cell—that mechanism, the so-called chromosomes which are easily visible through the microscope.

No two mother cells are alike, nor any two father cells; each contains a different arrangement of the hereditary characteristics, and so it is that every individual produced by the union of a father and mother cell is different from one produced by any other union. Although they are brothers and sisters, with the same heredity characteristics behind them to draw from, they have inherited these characteristics in such varying arrangement that they may vary as much as did the hundreds of people who were their ancestors on either side of the family.

A SINGLE DIVIDED CELL PRODUCES TWINS

Now it sometimes happens—we do not yet know why—that this original cell, made from the two parent cells, in one of its earliest divisions splits entirely in two, and the two halves, instead of remaining together as they usually do, remain separate and grow into separate individuals. In this case the two new individuals will have exactly the same heredity, and they are the only human beings we know of who have, and it is such individuals whom we speak of as identical twins. They are always of the same sex and always resemble each other to an extraordinary degree throughout the whole of their lives. Fraternal twins, who do not resemble one another, and who may not even be of the same sex, are the product of two unions of two different mother and father cells, and have simply happened to be born at the same time.

There are cases where two of triplets appear to be identical twins and the third to have originated from a separate cell. Cases of identical quadruplets are theoretically possible by assuming that the fertilized cell splits into four quarters. If one of these failed to grow, identical triplets would result.

IDENTICAL TWINS LIKENED TO DIVIDED PLANTS

We have then, in these identical twins, cases of human beings who start out, not as two different mixtures of the free and variable cells of their parents, but as halves, so to speak, of one mixture. To roughly illustrate the difference let us take two apple seeds. They have come from the same apple, but they will not grow into apple trees producing the same kind of apples. One may produce a tree which has a very fair apple on it; the other may produce apples which are too sour or bitter to eat. The trees themselves may even be distinctly different; one may grow upright and the other be spreading. The explanation is that they have different heredities at the very start—different pollen grains from a flower on the same tree have fertilized different egg cells in the young fruits. Supposing, however, we were to *divide a single seed* from an apple and that these two exact halves grew, would we not then be able to produce two apple trees which looked alike and which, when they bore, had almost exactly similar fruits on them? While it is not possible to divide the seed, horiculturists have found that they get almost the same result by dividing the plants after they are partly or entirely grown up. The whole great fabric of our cultivated varieties of fruit trees is built up on this approximate identity of the heredity of trees produced by growing them from parts—buds—taken from a single remarkable tree which produces delicious fruits, and putting them where they can grow and form thousands of orchard trees. Millions of navel orange trees, all of which produce fruits so much alike that even one who is not an expert can tell they are navel oranges at a glance, came in this way from a single bud which was put into a bitter-orange tree in Riverside, Cal., in 1870. The reason these all look so much alike, even though grown in California or Florida, is because their heredity at the very start was so nearly identical. They are not all *absolutely* alike as they are influenced by the climate and soil in which they grow. The flavor of a navel orange grown in Florida is different from one grown in California and quite as different from one grown in Bahia, Brazil, where the first buds came from; but they all have the navel which is so characteristic of the variety as to have given it its name.

Roughly speaking, then, identical twins can be compared with plants which have been propagated by the division of one individual.

ALL DIFFERENCES NOT APPARENT IN PHOTOGRAPHS

There are certain questions which may arise in the minds of those who look at these photographs. I surmise these will mainly deal with their invisible differences — differences in temperament, mental ability, tastes, mechanical abili-

TWIN ACROBATS

Even their mother cannot always tell Robert and Frank Michel apart; once she bathed the same little fellow twice. They are very much attached to each other and do not care to be separated for one minute. They even get hungry and sleepy at the same time. Although they are only five years old, they are clever little acrobats and work for moving-picture companies. It is interesting to know that their maternal grandmother was also a twin. (Fig. 1.)

EMINENT TWINS AS BOYS AND YOUNG MEN

The upper photograph is of Gilbert and Edwin Grosvenor with their older brother, Asa, as boys of four and a half years of age. The lower photograph is of the twins as students at Amherst. (See also following page.) (Fig. 2.)

EMINENT TWINS TODAY

If there were any theory that identical twins, starting from only half a cell, are lacking in mental or physical vigor, the record of the Grosvenor twins would shatter it. They both, as students at Amherst College, divided highest honors in the class room and on the tennis field, and one, as builder and director of the National Geographic Society, and the other as Assistant Attorney General and partner in one of the most important law firms in America, have demonstrated their abilities as leaders.

During their whole lives they have never varied more than a pound in weight. In college their grades never varied more than one-tenth of one per cent. Their tailor says that one of the twins has a short left arm and the other a short right arm. Although absolutely dependent upon glasses, each can wear the other's.

Their illnesses have often coincided. They have always been devoted friends, and frequently their letters cross. Most of their tastes are similar, but they never agreed when it came to girls. (Fig. 3.)

A MACHINIST AND A COMMERCIAL MAN

So near of a size that one can wear all the other's clothes, with color of hair, complexion and weight the same, differing in their taste for mathematics, but with voices considered identical, with an unusual fondness for one another, and with similar taste for classical and operatic music, the Ploger brothers of Owosso, Michigan, illustrate the presence of hereditary forces which keep those of practically identical heredity curiously similar through life. (Fig. 4)

ARE THESE ALIKE IN CHARACTER?

Anson and Friend Ingraham are now fifty-seven years old. That they are strikingly alike in appearance nobody will deny, and one wonders if they are alike in character.

What constitutes similarity of character? How could two souls be so alike as to be indistinguishable to their friends? How much variation in the physical structure of two brains would be required to produce quite different personalities? These questions, if studied more exhaustively, should bring us closer to an understanding of the physical basis of personality.

Mr. Anson E. Ingraham and his twin brother, Mr. Friend E. Ingraham, though no longer living in the same town, look as much alike as when they were boys. (Fig. 5.)

ties, etc. Let me suggest, as Dr. Frederick Adams Woods has pointed out, that we do not know how great or how small are the physical differences which are associated with very considerable differences in these invisible mental and moral characteristics. A close study of these photographs will reveal that no two of the most similar twins are absolutely alike. Perhaps there is some slight difference in the lobe of the ear or the direction of the hair on the forehead. Supposing there were as slight a difference in the lobes or convolutions of the brain, who knows what changes in intellect this might bring with it?

In studying these photographs and judging of their likenesses or unlikenesses, the fact ought to be kept in mind that our eyes are more critical about faces than about almost anything else. From babyhood we have studied each other's faces. Down through the ages from geologic times man has made a study of the human face, and it is hardly to be wondered at that he has a remarkable memory of its form and can tell at a glance whether he has seen a face which he once saw years ago. This form memory, heightened no doubt by natural selection, we bring to bear on these photographs, and differences so slight as to escape our attention in horses or dogs are immediately detected by us in these photographs.

It may not appeal to some as important that we learn which of our characteristics are hereditary and which are environmental, but to those who have given serious attention to the subject the matter appears to be of transcendent importance, involving as it does the whole question of our attitude towards each other as human beings, our understanding of the great race question, the limitations of education in the elevation of races, and the understanding of the fact, which is being continually lost sight of, that *acquired characters are not inherited*, and that education affects only the generation to which it is given.

Some of the most violent of our so-called race antipathies are based upon characters which are entirely environmental. Language is one of these. But table manners, fashions in foods and clothes and methods of living, styles of architecture, forms of address, attitudes towards music and painting, behavior in the relation of the sexes, emotional likes and dislikes on sight, respectfulness and attractiveness, obedience and disobedience, honesty and dishonesty, bravery and cowardice—all these reactions of the individual to his surroundings must be studied from the double standpoint to determine how far the response is the result of environment, and how far it is the result of heredity, for both factors are certainly there and must be given their proper weight.

When the barbers ascribe to the wearing of hats the bald heads of the old men, they are neglecting to give the right weight to the fact that a man inherits his particular type of baldness. When a woman ascribes her alarming increase in weight to the food she eats, she is often neglecting to consider the fact that she may have inherited the tendency to become large from her mother or her father, and the fact that she had a sylph-like form as a young girl tallies with the behavior of her mother or father when they were young. The old man past seventy who becomes convinced that his long life was caused by his not using tobacco or the fact that he never ate any butter, or that he always walked a mile or two a day, or that he took a cold bath every morning even if he had to break the ice to do it, should not overlook the fact that he comes from a long-lived ancestry nor that other fact, pointed out by Dr. Alexander Graham Bell,[1] that of 1594 individuals examined only 5% of those whose parents (both of them) died under eighty, themselves lived to be eighty; 10% of those having one parent who lived to be eighty and 20% of those having both parents who lived to be eighty, lived to be eighty.

[1] "The Duration of Life," Volta Building, Washington, D. C. "Who Shall Inherit Long Life" *Nat. Geographic,* June, 1919.

TWIN GIRLS WHO ARE STRIKINGLY ALIKE IN DISPOSITION

Differing slightly in height and weight and with a different way of walking, Lettie and Linda Johnson are otherwise as much alike in voice, in tastes and in disposition as they are in looks. They are both out-of-door girls and do not care much for reading. In school they got practically the same marks. Neither of them cares much for gardening or traveling. They are both fond of children and like animals, although they both detest spiders and snakes. They are unusually fond of each other and are always together, and even their handwriting is quite alike. The two boys are twins, evidently fraternal, and are not related to the Johnson girls. (Fig. 6.)

It seems to be a universal habit to ascribe a cause to every effect and one's peace of mind is satisfied in this way, whether there is any real proof of the connection between the two or not.

This collection of photographs of some of the more interesting of the 150 photographs of twins is published with the object of bringing to the attention of the readers of The Journal of Heredity the existence of thousands of human beings who have gone through changes of environment which we have been in the habit of considering sufficient to acount for all sorts of effects without varying enough in their likenesses to each other to make them easily distinguishable.

These photographs are published for the purpose of putting into the minds of as many people as possible this illustration of the force of heredity, so that they will appreciate the importance of the work of those men who are pushing into the field of its study. The field is worthy of the attention of the most brilliant minds of this age, and those who are successful in increasing the sum of our knowledge of it will most certainly be benefactors of the human race.

Should we not always remember that the sum total of our knowledge as compared to the future acquisitions of the human mind is as nothing; that we stand looking out on the world with the same blindness of vision that the mariners had when they saw every day the masts of the approaching vessels before the hulls appeared and failed to interpret the fact to mean that they were sailing round a gigantic globe?

I have some such impression when I look at this collection of the photographs of identical twins—identical from their babyhood through to old age. A study of them cannot be a trivial thing, and somewhere there must be a mind which will assemble the facts about them and bring these to bear on the greatest problem of the world, which is the understanding of what constitutes human progress.

COÖPERATION FROM THE TWINS

To those who have so generously volunteered themselves — and there were over 600 of them—as subjects for the study of the specialists of the American Genetic Association, I wish to express the deepest gratitude. Nothing has occurred since the establishment of the association which has so encouraged its officers as this response from the Twins of the World. It has given them a feeling of confidence that there is deep in the consciousness of everyone a keen interest as to what character of human race is to inhabit the globe after we are gone. That this interest will grow until it occupies the highest and most important place in human consciousness is the conviction of students of the new science of genetics.

The special studies made from the data supplied by the Coöperating Twins will be published from time to time in The Journal of Heredity, and such of the photographs as have been given to the association will be kept for reference purposes.

BOTH MARRIED BUT ONLY ONE WITH CHILDREN

For the first eighteen years of their lives, Rose and Louise Briot were always together, needing no other chums. Since then their lives have varied greatly. One is a widow and lives in the west near her children and grandchildren; the other is married but has no children and has lived always in Chicago.

Although their environment has been so different, the similarity between the twin sisters is in no way lessened. Their friends do not tell them apart any more easily, either when they see them or when they hear their voices over the telephone. As girls they often voiced each other's thoughts, and even now their letters cross repeatedly. Their mother, besides having twins herself, has twin great-grandchildren, and her brother has twin grandchildren, though neither pair are identical. (Fig. 7.)

THREE PAIRS OF TWIN GIRLS

Of the top pair their aunt writes that few can tell them apart, that there never has been more than a half pound difference in weight or a half inch difference in height.

Concerning the middle pair we have no information but their names and ages.

Mrs. Vera De Mott, of Battle Creek, Mich., and her twin sister (lower pair) were separated when three years of age and have always lived apart, seeing each other at long intervals only, yet that peculiar affection common to identical twins has always existed between them, and their characteristics have been so similar that even their best friends cannot tell them apart when they meet. (Fig. 8.)

RESEMBLANCE AND DIFFERENCE IN TWINS

Twins That Look and Act Alike Attract Attention First, While Dissimilar Ones Are Apt to Be Overlooked

C. H. Danforth
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As explained elsewhere in this number of the journal, the American Genetic Association began some time ago to accumulate a collection of photographs of twins. After a considerable number of twins had been found, a questionnaire was sent out to get data on resemblances and differences between the members of twin pairs. It is the purpose of this paper to discuss briefly some phases of the question that were emphasized by the answers received. The writer is indebted to the president of the Association for putting all the material at his disposal.

TWINS NOT ALWAYS ALIKE

Some of the photographs reproduced in this issue bear witness to the remarkable degree of facial resemblance that may exist between twins, while others illustrate the fact that twins are sometimes surprisingly dissimilar. What the photographs show with reference to facial resemblance, the questionnaires, filled out by the twins themselves, show for other traits, both physical and mental. While all types of twins are represented in the replies, there is some evidence, as will be explained below, that the material on hand comes from a somewhat selected group. For this reason it does not seem wise to present a tabulated summary of the answers. Such a tabulation would give the impression that the average resemblance of all twins is higher than it really is.

The questionnaire was so planned that it would afford data for comparing purely physical, more or less physiological, and mental traits including likes, dislikes and normal reactions. The answers may be briefly summarized under general headings.

Height.—Exact correspondence in height is not unusual, and a difference of a quarter of an inch or less is common. On the other hand, variations of several inches sometimes occur, and considerable differences are occasionally found between twins that are otherwise very similar.

Weight.—The resemblances and differences in weight are similar to those for height, but there is no absolute correlation between the two traits. Complete identity, or a difference of only a pound or two, is common. Some twins state that, while their weight fluctuates, the changes are always parallel so that they never differ from each other by more than a small amount. In other cases there is a wide divergence even when height and many other characteristics are similar.

Eye and Hair Color.—These features are generally given as similar. For example, one twin speaks of a "switch," perfectly uniform in color, made from the combings of both heads. Nevertheless twins, of which one is dark with brown eyes, the other light with blue eyes, are rather frequent.

Other Physical Traits.—So far as can be judged by the answers, other physical traits follow the same general rule as those already mentioned—almost complete identity in some cases, and wide divergence in others. In general, similarity with reference to one trait is correlated with similarity in reference to most other traits. Rarely are there only a few points in common;

still more rarely, what are otherwise similar twins may be characterized by one or two points of difference. As an illustration of the latter class, there may be mentioned a pair which in a baby show were scored as identical except for the shape of the occipital region of the head.

Physiological Traits.—Such manifestations of the general make-up as gait, sound of the voice, reaction to foods, susceptibility to disease, all show a distribution similar to that of the purely physical traits. One pair of twins state that bananas make them "both very sick." Another pair have no special aversion for any food but tapioca. Still another pair agree in all their likes and dislikes except for canteloupe. In other cases the lists of preferences differ very considerably.

THE "MIRROR IMAGE" OF EACH OTHER

Perhaps the matter of right and left handedness should not be passed over in this connection. Rather a surprising number of twin pairs seem to be composed of one right and one left handed individual. It has been suggested that one twin is frequently the "mirror image" of the other, left-handed and with heart and other viscera reversed in their symmetry. The responses to the questionnaire do not show definitely whether or not this condition, known to anatomists as *situs inversus*, occurs in any of these twins. Some persons believe that right or left handedness is an acquired characteristic and not hereditary. While this position probably cannot be maintained, it may be of interest to recall that twin babies generally face each other in their beds, and if care is not taken to change them about frequently their heads become asymetrical on opposite sides. This may possibly affect the hemisphere of the brain differently and certainly influences the amount of use that is made of the left hand in one infant and the right in the other.

Handwriting.—Each twin was asked to copy a short sentence. The handwriting of the two members of a pair frequently showed great similarity and in one case was virtually identical. In other instances the differences in style and other characteristics were very noticeable.

Mental Traits.—Much of the information received through the questionnaires concerned mental capacities, intellectual tastes, and likes and dislikes. Without analyzing this data in detail it may be stated that ample evidence is afforded that the same resemblances and differences obtain with reference to mental traits as are found for characteristics that are generally thought of as more purely physical or physiological. Over and over the two twins of a pair enumerate virtually the same list of preferences and aversions. One pair of twin girls heartily dislike mathematics, while another pair record it as their favorite study. One twin mentions that not only do she and her sister commonly dream about the same person at the same time but they dream the *same things* about them. She states that this happens even when they are in different places.

STRONGER AFFECTION

Many twins state that their fondness for each other far exceeds their liking for other brothers and sisters. Both men and women twins write that they are always dissatisfied when separated from their co-twins. "No one was ever quite so entertaining to us as the other." It is noticeable that twins who express this sentiment are not only of the same sex, but otherwise similar.

On the other hand there are plenty of twins who differ widely in their tastes and capacities and who find their co-twin no more congenial than their other brothers and sisters, indeed sometimes less so. These are the "Jacobs and Esaus," as a twin in an insane asylum once explained to the writer.

Summary.—Summarizing this very sketchy review of the questionnaires, it may be said that there is ample evidence that the twins of certain pairs show profound resemblances in both physical and mental traits, while those of other

TWINS AS DIFFERENT AS ANY SISTERS

These little twin sisters have grown up together in the same surroundings and under the same influences; even their prenatal influences were the same. Yet they are so unlike as to be almost opposite in every characteristic, so much so that their education and management has been quite a problem.

These two girls, born at practically the same time, of the same parents, and yet with such different characteristics, illustrate clearly the difference between identical parentage and identical heredity. Both are mixtures of the same two human stocks—the maternal with its long line of ancestors and the paternal with its own line. But each girl is a different mixture or combination of these stocks—in one more of the paternal perhaps and in the other more of the maternala ppears. They doubtless arose from separate egg cells. (Fig. 9.)

STRIKING CONTRASTS DUE TO DIFFERENT HEREDITY COMBINATIONS

These triplets, in the top picture, show in a very striking way the difference between fraternal and identical twins. The two little girls at the right are probably identical, while the boy at the left has evidently a very different combination of the hereditary elements of his parents. The mother of the little twin boys, shown at the bottom, writes that they are so "utterly unlike in every way that it is hard for anyone to realize they are twins." (Fig. 10.)

ENGLISH TWIN GIRLS

In each of these photographs of the Misses Stallard of Portsmouth, England, one of the twins holds her head down a little, while the other one holds hers up. If it is the same one who does so in each picture, it is probably a characteristic difference, but that seems to be the only difference there is. (Fig. 11.)

pairs show no such unusual similarity. The resemblance between similar pairs is never quite complete and practically every pair is found to differ more or less widely in at least one respect. On the whole one might gain the impression that while absolute identity is not attained, rather marked similarity is, with rare exception, the rule.

DIFFERENCES AND SIMILARITIES EXPLAINED

It may now be of interest to seek an explanation for these likenesses and differences, and particularly to try to explain the intermediate grades of resemblance

The similarities of some twins and the differences of others are commonly explained on the familiar assumption that there are two classes of twins, those derived from a single ovum and those derived from two separate and independent ova.[1] The former, having identical heredity, are similar, while the latter, arising from different ova and different sperms, are dissimilar. Both of these types furnish strong evidence for the overwhelming potency of factors of heredity as compared with those of environment. In the one case the resemblance persists, as can sometimes be shown, in spite of dissimilar environments, while, in the other, identity of home surroundings, food, and even clothes fails to lessen inborn differences.

It cannot be maintained, however, that heredity is the sole factor in determining the characteristics of the individual. Thorndike[2] has found, for example, that many twins which are undoubtedly biovular in origin resemble each other more than they resemble their other brothers and sisters. While this is not Thorndike's conclusion, the observation might be interpreted as indicating the possibility of an environmental influence. Since it is also to be observed that uniovular twins are never quite "identical," it is conceivable that their differences might be due to environmental factors. How far such similarities in the one case and differences in the other are in reality directly induced by the environment cannot be easily answered. A few considerations bearing on this question may be of some interest. In this connection there are three questions that it may be profitable to consider: (1) Are the resemblances of uniovular twins confined to certain traits or does the similarity pervade their whole being? (2) Apart from environmental influences, how great is the similarity that may be expected between biovular twins? (3) How great are the differences that may be expected to appear in uniovular twins?

In regard to the first of these questions it will at once be apparent that many of the so-called superficial resemblances are in reality expressions of more deep-seated similarities. The color of the hair and eyes is due to fundamental factors in the make-up of the individual. The gait and many other peculiarities that might seem superficial are the product of the condition of the muscular and nervous systems. Some few dissections of twins have been made, and these revealed remarkable similarity in the configuration of the brain[3] and in the muscles and blood vessels.[4] So there is every reason to believe that the resemblances between twins are fundamental, involving all parts and systems. But while every part may be concerned, there is some indication that the total resemblance is due not to some general quality that the two individuals have in common, but rather to the sum of the many similar special traits which, added together, give the individual his character. On this assumption we can understand at least a part of the cases in which there is

[1] For a fuller discussion of this matter the reader may referred to an article in this journal, vol. vii, No. 5, pp. 195-202, "Is Twinning Hereditary?"

[2] Archives of Philosophy, Psychology and Scientific Methods, No. 1, 1905.

[3] Sano F.: "The convolutional pattern of the brains of identical twins: a study on hereditary resemblance in the furrows of the cerebral hemispheres." Phil. Trans. Roy. Soc., Lon., Series B, vol. ccviii, pp. 3761, 1916.

[4] Danforth, C. H.: "A comparison of the hands of a pair of polydactyl negro twins." *Amer. Jour. Physical Anthropology*, vol. ii, pp. 147-165, 1919.

similarity in some respects and dissimilarity in others, for it may be assumed that the traits are not all quite identical. Stated in other words, there would seem to be evidence that all bodily and mental traits tend to be similar in certain (mostly uniovular) twins, but that it is not unusual in twins of either type to find differences, now in one trait and now in another.

EXTENT OF SIMILARITY IN BIOVULAR TWINS

In regard to the second question, it may be assumed that biovular twins will on the whole resemble each other to a degree about equal to the average for all children of the same family. In individual sets the degree of resemblance will vary widely, since the possible combination of traits from the maternal and paternal germ plasms are very many.[5] It is conceivable that occasionally (with our population and birth rate, perhaps once in eight or ten years) a pair of biovular twins would be born with identical germ plasms. More frequent should be biovular twins differing in only one chromosome, and progressively more frequent the pairs differing by larger and larger degrees until the average of fraternal resemblance is reached. Then progressively less frequent should be pairs differing to increasing degree below the fraternal average.

Since most pairs of parents have many points in common, perhaps selecting each other on the basis of community of physical as well as mental traits,[6] the possible average of combination of traits within a given family is somewhat reduced and the likelihood of children with similar germ plasm correspondingly increased. If two very similar children are born a few years apart, their likeness may be easily overlooked—the photograph of a boy at eight and the same boy at fourteen may show no more than a family resemblance—but when such similar children happen to be twins of the same sex, even though the degree of resemblance is such as could easily be matched in other brothers and sisters who are not twins, the similarity of age and frequently of dress immediately becomes noticeable. Such twins will pass among their friends as strikingly similar. It is interesting to note that in submitting photographs, many twins explain that they are really more alike than their pictures indicate. On *à priori* grounds, then, many pairs of biovular twins should be expected to show resemblances, either real or apparent, that would be much above the average for the ordinary run of brothers and sisters.

TWINS OF DIFFERENT TRAITS OFTEN OVERLOOKED

It will no doubt be objected that, for every pair of biovular twins which show a resemblance greater than the average fraternal resemblance, the laws of chance lead one to expect that there will be another pair that will show a corresponding dissimilarity, bringing the average resemblance down to that for brothers and sisters in general. Assuming that the distribution of traits in biovular twins at birth is in accordance with the laws of chance, and ignoring the possibility of subsequent environmental selection (*e. g.,* by disease) against dissimilarity in children, there remains an important factor to be considered in any study of twins that have passed the age of infancy. This is the likelihood of overlooking twins who do not closely resemble each other. Children who differ widely in general appearance, size, mental capacity and tastes are less likely to be together, more likely to leave school at different times and, curiously enough, often take little interest in the fact that they are

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[5] On the assumption that chromosomes maintain their individuality and that "crossing over" does not occur, there would still be no less than 4,096 possible kinds of germ cells to be produced by a given individual of either sex.

[6] Harris, J. Arthur: "Assortative Mating in Man." *Pop. Sci. Monthly,* vol. lxxx, pp. 476-492, 1912.

BORN AT THE SAME TIME BUT OF DIFFERENT SEX

Fraternal twins—like Merton and Myrtle Collins—are not more alike than if they had been born a year or two apart. Merton has blue eyes and fair hair and is near sighted, while Myrtle is dark with dark brown eyes and good eyesight. Except in mathematics their abilities are about the same, and they have quite similar likes and dislikes. They are unusually fond of each other. No cases of identical twins are known in which they differ in sex nor are such conceivable as our knowledge of heredity stands today. (Fig. 12.)

twins. In any statistical studies on school children or inquiries addressed to twins themselves this group tends to become lost, a fact that was interestingly brought out in the responses of twins to the requests for photographs. Of 160 pairs whose pictures were submitted 77 pairs were women or girls, 61 pairs were men or boys, and only 22 pairs were of both sexes, most of the last being children whose pictures were sent in by their parents. Statistics based on thousands of cases show that about one pair of twins in every three pair born consists of a boy and a girl, yet, despite the fact that the appeal sent out to the newspapers asked for pictures of twins irrespective of their sex or resemblance, "pigeon" twins were not sufficiently interested to coöperate or to show curiosity to any appreciable extent. Similarly, by an easy deduction,[7] it can be shown that twins of the same sex should be uniovular in about two cases out of five, yet in the opinion of the writer those twins of like sex who submitted their pictures show very striking resemblances in at least three cases out of five. This seems to indicate that even where both twins are of the same sex the interest in each other is roughly proportional to their resemblance.

The conclusion with reference to our second question would seem to be that biovular twins should be expected to show resemblances in hereditary traits ranging from practical identity to wide divergence, and that in any ordinary collection of photographs or data supplied by twins themselves or their friends they will *seem* to show an average degree of resemblance greater than that for brothers and sisters in general. That is, of course, entirely apart from any environmental influences that might be supposed to still further heighten their resemblances.

WHY ARE THERE DIFFERENCES IN UNIOVULAR TWINS?

While known facts furnish a basis for understanding the marked similarities that sometimes exist between biovular twins, considerable difficulty is experienced in explaining the differences that occur in twins known, or assumed, to be uniovular. Why are these twins not actually identical? The answer to this query must wait, but there are a few points that may throw some light on the question. In the first place, it is a matter of common observation that the two sides of the same individual are by no means identical. It may be recalled that a few years ago it was a fad with certain newspapers to secure full-face views of prominent people and, dividing them in the median line, reproduce a left side to correspond to the right and a right to correspond to the left. The faked pictures were then printed showing Mr. Blank as he would look (*a*) if the left side of his face were symmetrical with the right and (*b*) if the right side were symmetrical with the left. The hair line, the arch of the eyebrows, the shape of the eyes, the ears, and the mouth, the facial expression, were often very different in (*a*) and (*b*), so much so that in some cases the two pictures would hardly have been supposed to represent uniovular twins. Anatomists are familiar with the rather frequent departures from symmetry in bilateral muscles, nerves and vessels. Occasionally individuals occur with one blue and one brown eye, and indeed it is probable that all symmetrical parts of the body are subject to occasional unilateral variations. The origin of these variations, however, is probably not environmental in the usual sense, since here the environment factor is reduced to its minimum.

Whatever may be the cause of variation between the two sides of the body when they develop together as a single individual, it is reasonable to expect that they will be equally effective when each half of the blastoderm develops as a separate individual. It might therefore be predicted that uniovular twins would differ from each other in the

[7] See article by Margaret V. Cobb in *Science* N. S., vol. xli, No. 1057, pp. 501-502, April 2, 1915.

same respects and to the same degree as the two sides of the body differ in ordinary individuals.

Whether the fact that a twin is developed from only a part of the ovum while the ordinary individual is developed from all of it makes the two sides of the twin any less variable is not definitely known, but Professor Wilder[8] makes the interesting suggestion that it does and that twins are therefore apt to be more symmetrical than ordinary individuals. Moreover, it is possible, so far as we can see, that occasionally—although rarely, no doubt—they may differ not in one or two particulars but in many, giving uniovular twins which are decidedly different. These facts help us to understand, if not to explain, why uniovular twins are not really identical in the strict sense of the word.

The theoretical considerations briefly set forth in the preceding paragraphs may serve to account for most of the resemblances and differences actually observed among twins. They help us to understand why uniovular twins are not absolutely identical and why biovular twins are often very similar. In the same facts we find an explanation for those intermediate grades of resemblance that often prove so puzzling but which, after all, seem to be due more to the inherent constitution of the germ plasm than to influence of the environment.

TWINS WHO INHERITED NIGHT BLINDNESS

Mr. E. C. McCurdy and Mr. R. G. McCurdy feel very strongly that all identical twins are fonder of each other than ordinary brothers and sisters. The McCurdy twins are also fond of the same things, and they like children and animals, enjoy the same kind of diversions, foods and intellectual interests, and they share an abhorance of bugs, spiders and snakes. They both suffer from night blindness and neither can get about at night, although they both have a good sense of direction. Their handwriting is very different. (Fig. 13.)

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[8] Wilder H. H.: "Palm and Sole Studies." *Biological Bulletin,* vol. xxx, 1916. For a further discussion of symmetry in twins see "The Biology of Twins," by H. H. Newman, University of Chicago Press, 1916.

TYPICAL IDENTICAL TWINS

These sturdy little twins are certainly as much alike as any two peas. It would be interesting to watch them throughout their lives, particularly should they live in different countries, subjected to different climatic conditions. (Fig. 14.)

PHYSICAL CORRESPONDENCES IN TWO SETS OF DUPLICATE TWINS[1]

Striking Degree of Identity Shown in Bodily Measurements and Skin Patterns of Palms and Soles

Harris Hawthorne Wilder
Professor of Zoology, Smith College

We are now, thanks to the long-continued researches of *Newman and Patterson,* absolutely certain that all the members of a single litter of young armadillos come from what is originally one egg, fertilized by one spermatozoon, and that the striking similarities in certain details of the individual members are due to the fact that all develop equally from the same germ-plasm and thus inherit the same characters.

Human twins of the duplicate type[1] show precisely the same degree of correspondence in similar parts, for the friction-ridges of the palmar and plantar surfaces, made from the fusion of epidermal units (scales?) in rows correspond morphologically very closely to the rows of scales in the armadillo carapace. It may thus be expected *à priori* that the degree of correspondence in the two cases would be about the same, and this, as nearly as can be estimated by the inspection of many cases in each, seems to be the case. Both in normal sets of armadillos, and in man, in the rather frequent cases of true duplicates, we have undoubtedly instances of typical *polyembryony,* with remarkable correspondences in numerous characters, more than is likely to be found in single individuals from separate eggs.

Naturally on the basis of development of twins from either a single egg or from two separate ones, there must be two and two only sharply defined classes, with no possibility of intermediate or transitional forms, and consequently the presence of *doubtful cases,* where, perhaps, neither the facial resemblance nor the palm and sole configuration is absolutely conclusive, threatens the security of the whole theory. It is very encouraging, however, to hear from Newman a plea for the classification of certain doubtful cases formerly published by me as such, under the head of true duplicates, where the departures from identity are only of about the same grade as those occasionally met with among his armadillos, where there is absolutely no doubt that they are from a single egg, and therefore duplicates.

It is also quite possible, on the other hand, that either fraternal twins, or children of different births but with the same parents, may show many similar qualities, since very similar combinations of character may chance to occur. Indeed, with all the possibilities of linkage, and with the consequent tendency to the association of large groups of characters, it would be unlikely that such duplications did not occasionally occur. One such case has come under our direct observation, where there are three sisters in a certain family, two of them fraternal twins, and where the younger single sister so closely resembles one of the twins that she is generally considered by strangers to be herself the other twin, while the latter is of a quite different type, markedly unlike the other two. Here, evidently, is a case of three distinct eggs, two born at the same time, and one at a subsequent birth, but with a similar composition in the germ plasm of this latter and one of the two born simultaneously.

[1]The term "duplicate," which the author uses throughout this article, has the same meaning as the term "identical" used by the other authors writing in this issue.—Editor.

STRIKING SIMILARITY IN PALM AND SOLE PRINTS

In several papers during the past twenty years I have put forth as an exact criterion of the degree of bodily correspondence between twins the use of the friction-skin patterns covering the surfaces of the palms and soles; parts the individual character of which is now well known. Sir Francis Galton and others, notably Féré, have made careful comparisons of the finger-print patterns, with for the most part rather inconclusive results, but in my opinion these areas are too small and the variations too slight to serve well for the purpose. The larger area presented by an entire palm or sole, on the other hand, allows the delineation of a much more extended pattern, or rather a series of patterns, in which the general configuration of the whole surface may show a striking similarity not even noticeable in a single detail of the size and importance of a finger-print only.

The result of the study of some fifty sets of twins in this particular justifies me in making the following claims:

1. The friction-skin configuration of twins corroborates the conclusions based upon the general physical appearance, that there are two distinct types of human twins, *duplicate* (or identical) and *fraternal.* Twins of the first type are monochorial at birth, and represent typical cases of polyembryony, similar to the normal condition in armadillos; those of the second type are dichorial, and represent simply cases of multipary, the normal condition in many small mammals like dogs and rabbits.

2. Twins of the first type show the high degree of facial and bodily resemblance noted throughout this magazine and illustrated through photographs; those of the second type either may or may not look alike, as in the case of any brothers or sisters of distinct birth. Twins of the first type are necessarily of the same sex; those of the second may be either of the same or of opposite sex, as in any two children of one family.

3. The correspondence in the friction-skin configuration is confined to the general plan of the surface as a whole and does not extend in the least to the finer details, the "*minutiae*" of Galton. Thus a loop pattern upon a given area of the right hand of one twin will be found, usually to about the same degree of development, in the corresponding place on the right hand of the other, but there will be no similarity in the number of individual ridges of which the loop is composed in the two cases; technically, the "ridge-count" in the two cases will be different. The two will present the same painting, but with different brush-marks. Heredity determines with considerable precision the occurrence and arrangement of patterns and other larger features, but the execution of them, as drawn by the ridges, is wholly individual, and is *quite beyond the limit of hereditary control.*

4. Not only does the degree of development of a given pattern in the two twins differ within considerable limits, but it frequently happens that a definite pattern in one twin may be represented in the other by nothing more than a convergence of lines representing the last vestige of the pattern in question. In such cases, however, there is always a well-marked and definite area left for either the pattern or the pattern vestige, thus keeping the general plan of the whole area.

5. In duplicate twins there is, in both hands and feet, a marked correspondence between the two sides, so that the right and left hands of each twin correspond as completely as do the right or the left hands of the two individuals. All four of the hands involved are thus duplicates of virtually the same picture, and the same phenomenon is shown in the four feet. It is true that in normal single individuals some form of bilateral symmetry between the two sides is often found, but this is seldom as complete as in duplicate twins. There are found also all grades of dissimilarity between the two sides, while they are often entirely unlike. Then, too, if

PALM PRINTS OF THE M——— TWINS (male)

Prints of the left hands of Henry (left) and Bernard (right) when these twins were twelve years of age. The lines of interpretation are traced out with India ink upon the actual prints. "The correspondence in the friction-skin configuration is confined to the general plan of the surface as a whole, and does not extend in the least to the finer details." (Fig. 15.)

PALM PRINTS OF THE M—— TWINS (males)

Prints of the right hands of Henry (left) and Bernard (right). "A loop pattern upon a given area of the right hand of one twin will be found, usually to about the same degree of development, in the corresponding place on the right hand of the other, but there will be no similarity in the number of individual ridges of which the loop is composed in the two cases." (Fig. 16.)

the hands are similar the feet are likely to be unlike, and vice versa, so that complete correspondence between the two sides of an individual, and extending to both hands and feet, is extremely rare in single individuals, or may be said never to occur, while in duplicate twins the phenomenon is universal and occurs in both members.

As an excellent illustration of the palm and sole prints of duplicate twins we may first present a complete set from the two M—— boys of Portland, Me., taken about fourteen to fifteen years ago when they were twelve years old. Aside from being perfect duplicates these prints show in the hands the full set of eleven possible patterns to be expected in a palm when in its most complete form, as follows:

5 apical patterns ("finger-prints").
4 interdigital patterns (below the four intervals).
1 thenar (at the base of the thumb).
1 hypothenar (upon the fleshy pad on the side of the palm corresponding to the little finger).
—
11

As is universal in man, in cases where these patterns occur at all, the first interval between thumb and index, is found in close association with the true thenar, placed just below it, together making a sort of double pattern at the base of the thumb. As is also usual in such cases the interdigital member of this compound pattern is small or vestigeal and is represented by a simple loop, opening upwards or distally between digits 1 and 2. On the two left hands, as would be expected from the fifth rule above, the record is nearly as complete as to the presence of the eleven patterns, save that in both the second interdigital, between digits 2 and 3, is wanting, although its place is defined clearly by a marked-off area where it would be expected. This pattern is normally of rare occurrence, and even when present is scarcely ever more than a small loop, involving few ridges. A whorl here has not as yet been reported.

The occurrence of all the typical eleven palmar patterns, such as is seen in all four of the hands of this set, is in single individuals one of the rarest phenomena. Among more than 1,200 single individuals my collection shows it but once or twice. The combination of the true thenar with the first interdigital is almost constant when either pattern appears at all, but in the white race this is only in about 4% of all cases, so that in any two individuals taken at random, if one of them has this pattern, the other has just one chance in twenty-five of having it also. One must acknowledge, however, that in children of the same family, where one parent has such a pattern, it is almost certain to appear in all or nearly all. Similarly, the percentage of occurrence of each of the other patterns must be reckoned with by itself, and the total chance of the appearance of each and every one of the typical eleven in any one individual becomes very slight. The chance of this complete occurrence in any two brothers, not twins, is naturally but one in a number represented by the square of this first number, naturally so large a one as to practically preclude its appearance otherwise than as the result of some genetic principle which must be considered as causal.

CORRESPONDENCE IN BODILY MEASUREMENTS

For many years now this case of the two M——s, with its many features that have to be duplicated, has been my best case, because of the many separate features involved, but recently there has appeared a second case, equally complete, where, too, in addition to the palm and sole prints, there has been obtained a full set of bodily measurements. These are the B——s, students of Smith College, and evidently, from the close facial and general physical correspondence, duplicates. From the tracings, which are here presented, instead of the actual prints, the complete representation of all eleven patterns is evidently as good as in the other case.

SOLE PRINTS OF THE M—— TWINS (males)

The prints at the top are those of the right feet of Henry (left) and Bernard (right); those shown at the bottom are of the left feet of Henry (left) and Bernard (right), the lines of interpretation being traced out with India ink upon the actual prints. Although the individual ridges may seem to differ to a large extent, the general pattern of the whole surface shows a striking similarity of outline in cases of identical twins. (Fig. 17.)

The three last interdigital patterns, those of the upper row, are, with the exception of the first one of this row, really the second interdigital, on the left hand of Mabel, large and well-developed, rather better, in fact, than in most cases in the M—— hands. There is again almost a failure of the hypothenar, also in the left hand of Mabel, which shows the other lack. The right thenar of May is also weak, but well indicated. In only one of the four was the little extra loop (= first interdigital) printed, the left of May, but the prints are probably deficient in this region in the others, owing to faulty technique in printing.

The feet of both sets, as in the case of the hands, happen to be decidedly similar to the M——s, and with the same slight discrepancies, occasionally amounting to a lack of harmony in one of the main features, as has been noticed in the hands. For instance, note the third interdigital of the left feet of the two M——s, where the ridges taper to a point, but develop no lower triradius, as in the rights; also the fourth, or last, interdigitals of the two B——s, which show but one real pattern out of the four, the one on the right foot of May.

RESEMBLANCES CONTROLLED BY GERM-PLASM

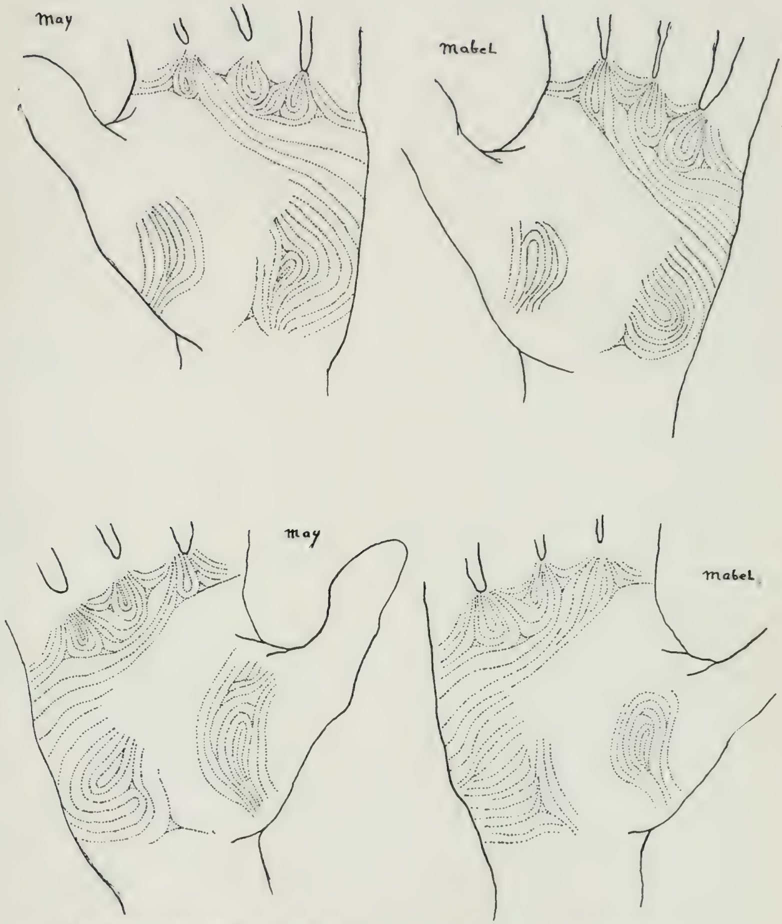
Recapitulating, the general similarities, with various minor departures therefrom, appear in these two cases about as in other typical cases of twins that closely resemble each other, and which, for these and other reasons, may be considered *duplicates*. The resemblance is close, but not exact, and never extends to the ridge details, the minutiae of Galton. The conclusion is hard to avoid, that, as has been done by Newman and Patterson in the similar correspondence of the ridges of the carapace of armadillos, the correspondences are of those parts that are under the control of the germ-plasm, and that where there is no definite correspondence the development is left to other forces, whatever they may be.

The bodily measurements of the B—— twins were taken in the nude by a graduate student, Miss Margaret Washington, and constituted a part of the similar careful measurements of 100 students used in the preparation of a thesis. These twins were taken towards the end of the series, after the measurer had had the greater part of her practice, and the results may be relied upon as accurate. The measurements were taken in millimeters by the anthropometer of Martin, made by R. Hermann, of Zürich, with the occasional use of other instruments from the same source. Miss Washington followed, both in the selection of the measures to be used and the technique by which the measures were taken, the International Prescription of the Congress of Geneva, in 1912.

The measurements of the two are as follows:

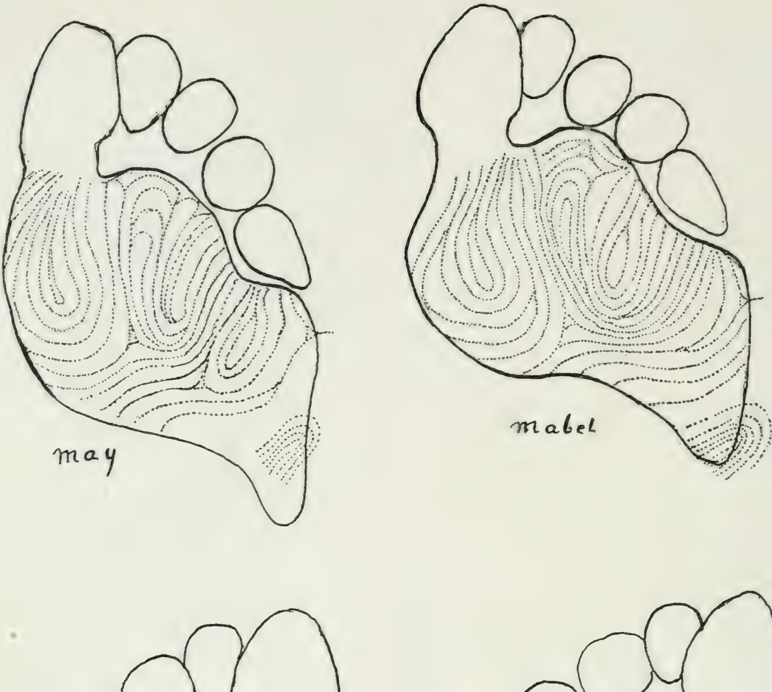
	May	*Mabel*
Total stature	1668	1669
Arm stretch	1631	1621
Height; tragus	1522	1521
Height; vertebra prom.	1431	1431
Height; incisura sterni	1361	1360
Height; acromion	1349	1361
Height; nipple	1248	1233
Height; umbilicus	1030	1020
Height; ant, spine il.	966	964
Height; trochanter	911	891
Height; symphysis	879	885
Height; olecranon	1055	1080
Height; styloid radius	822	838
Height; end middle finger	621	639
Breadth; biacromial	340	337
Breadth; cristal, il.	255	254
Breadth; spinal, il.	250	256
Breadth; trochanteric	205	205
Breadth; nipples	190	195
Breadth; thorax	232	236
Depth; thorax	175	175
Length; foot	254	251
Stature; sitting	848	840
Vert, prom; sitting	620	613
Incisura sterni; sitting	551	530
Acromion; sitting	539	530
Head length	185	185
Head breadth	142	142
Frontal breadth	97	96
Breadth between eyes	28	27
Zygomatic breadth	116	116
Breadth of jaw, angle	96	95
Chin-hair length	185	188
Chin-nasion length	122	122
Nasion-prosthion	76	76

(*Continued on page* 419)



TRACINGS FROM PALM PRINTS OF THE B—— TWINS (females)

The two at the top are of the right hands of May and Mabel at eighteen years of age
Those at the bottom are of the left hands of the same twins. These illustrations were made
by tracing the essential lines through the actual prints by means of carbon paper, and thus
transferring them to blank white paper. They thus correspond to the inked lines seen on
the prints in Figures 15 and 16. (Fig. 18.)



TRACINGS FROM SOLE PRINTS OF THE B—— TWINS

Made in the same manner as those shown in Fig. 18. Those at the top are of the right feet, and those at the bottom, the left feet of May and Mabel. "Heredity determines with considerable precision the occurrcnce and arrangement of patterns, and other larger features but the execution of them, as drawn by the ridges, is wholly individual, and is quite beyond the limit of hereditary control." (Fig. 19.)

	May	Mabel
Length of nose..............	60	60
Breadth of nose	29	28
Length of ear	58	58
Breadth of ear	31	29

Color of eyes, hair, and skin, obtained by comparison with the standard numbers of the tables prepared by P. Hermann, namely, the eye color table of Martin; the hair color table of E. Fischer, and the skin color table of Luschan. The numbers are as follows:

Color of eyes	No. 15	15
Color of hair	No. 8	8
Color of skin	No. 3	3

At the time of the measurements the twins were eighteen years old.

From these tables, which give the actual height from the floor of numerous points upon the trunk and limbs, many other measurements may be obtained through subtractions. Thus the total length of the arm is obtained by subtracting the height of the extended middle finger from that of the acromion; that of the arm alone by subtracting the height of the styloid process of the radius from the same height, that of the acromion. Similarly the olecranal height, which is that of the head of the radius, with the styloid height taken from it, is exactly the length of that bone and may be considered as that of the forearm.

To apply this, the total arm-length of May is 1,349 — 621, or 728 mm.; while that of Mabel is 1,361 — 639, or 722, showing an insignificant difference of 6 mm. For the arm alone, without the hand the figures are respectively 527 and 523. It will be noticed that the height of the acromion differs almost more than any other height, which is due to the impossibility of always holding the shoulder skeleton, with its mass of muscles, at just the same level.

For this cause there is always fully as much variation in the measurement of the acromial height of the same individual taken at different times; and as the total arm lengths are so nearly alike in the two twins, it is fair to consider the normal, or average, acromion height as practically the same in both.

The leg height, or that from the head of the femur to the ground, is quite impossible to get directly, owing to the depth to which this part of the femur is imbedded in the soft parts. Many workers take as a good substitute the height of the iliac spine, and from this subtract 40 mm.; others subtract the total sitting height from the total standing height. By the first method the two twins, in the order used here, have as leg lengths, respectively, 926 and 924 mm.; by the second the leg lengths are 820 and 829. These last are not really leg lengths at all, but represent merely that portion of the total stature remaining after the subtraction of head and trunk, and hence are much less than the true leg length, or that of the femur and tibia together with that portion of the foot used in standing.

The trunk length, measured to the plane of the ischia in the sitting figure, may either include the neck vertebrae and be measured from the upper plane of the atlas, or may be that of the trunk alone, beginning with the thorax. In the first case one may also use the tragus height or that of the subnasale, both of which fall at about the plane sought when the head is placed in the usual position, with the eyes looking straight forward; in the second, one has the choice of either the suprasternal notch or the vertebra priminens. These heights are in all cases measured down to the plane of the table upon which the subject is sitting and give the various trunk heights, with or without the neck. With the inclusion of the neck, using the vertebra priminens for the upper limit, the trunk lengths of the two girls are, respectively, 620 and 613, the slight difference being easily accounted for by a slightly different degree of relaxation in the two spinal columns, causing a similar difference in the shape of the lumbar curve. Using the incisura sterni, however, and thus excluding the neck, the figures given are 551 and 530. These are considerable, rather more than in other cases, and although they are possible, it is quite likely that we have here a clerical error, made during the measurement or the later copying, as the fig-

ures used here were twice copied. The fact that in the second twin the same number, 530, is also given as the acromial height, and occurs on the list immediately beneath it, suggests such an error as an easily explained possibility.

CLOSE IDENTITY IN PHYSICAL STRUCTURE

Taking, now, the figures directly from the tables, there are some very striking similarities, amounting in a few cases to complete or practical identity. Thus, starting with a total stature of 1,668 and 1,669, we find the height of the vertebra prominens and that of the incisura sterni the same exactly, while the height of the tragus has but a single millimeter of difference. The heights of the very mobile shoulder girdle and of the parts of the arm depending from them, as already explained, cannot be expected to be constant, but the length of the arm and its parts in the two, as obtained by subtraction of heights from one another, is very close. As for breadths, the biacromial differs by but 3 mm., the cristal, across the hips, by 1, and the trochanteric not at all. In thoracic measures we have 232 x 175 and 236 x 175, where the 4 mm. difference in one dimension alone is negligible. The length and breadth of the two heads is identical in both twins, 185 x 142, and it is also significant that the facial measurements show so close a similarity. The few measurements of the soft parts, the nipples and the umbilicus, are of minor importance, as they do not depend upon a bony support and are easily changeable. Taken in general, there is a surprising degree of identity in the bodies of these twins.

This test of bodily measurements offers an important field in the investigation of twins. They should be measured while young, before the varied experiences of after life have effected much modification, but after maturity is reached. It would be also of interest to get several series of such measurements of the same sets of twins during growth, from infancy to maturity. From such studies could be learned, for instance, the effect of various illnesses undergone by one twin and not the other, and in such things could be found explanations for many of the slight lacks of complete correspondence which are out of harmony with what would be expected in genuine duplicate twins.

A MARKED DIFFERENCE IN GROWTH

These little twins have both had four years in which to grow. Just what were the forces that checked the development of the smaller boy, could not be ascertained. Very likely it was an early illness. The mother, Mrs. S. Cooper of Newark, N. J., states that the "smallest boy is doing fine now and is very bright and lively." We have no evidence that these are identical twins. (Fig. 20.)

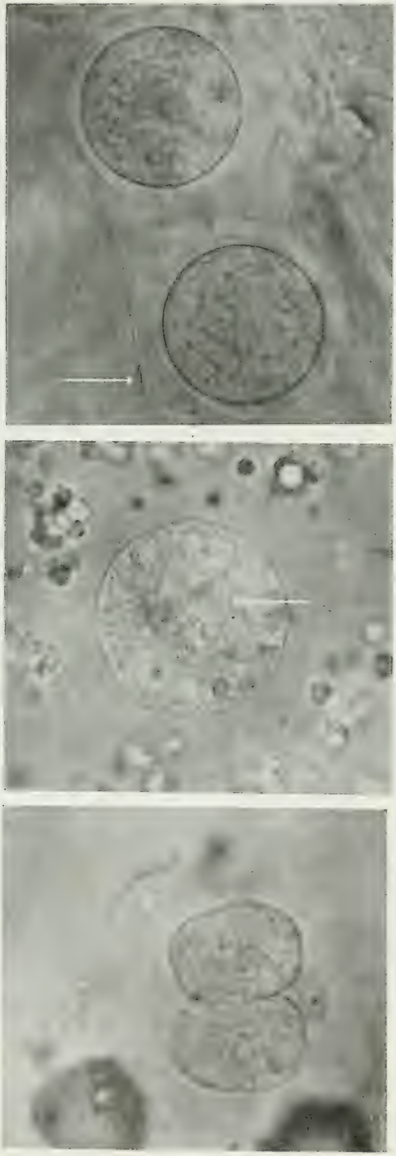


Fig. 21

Carriers of the Germ Plasm

The two large spheres in the top picture are egg cells, alive in Ringer's solution when photographed. A single whip-like spermatozoon may be seen at the point of the arrow. The penetration of an egg cell by a single spermatozoon results in a cell, the fertilized egg, which has within itself the power of developing into a new individual when properly nourished.

The middle picture shows an egg cell which has been penetrated by a spermatozoon. The unabsorbed tail of the latter can be seen next to the single nucleus produced by the fusion of the egg and sperm nuclei.

A living egg in the two-cell stage appears in the illustration at the bottom. Under normal conditions the two cells into which the egg cell divides after fertilization remain together and become the millions of cells which form a single individual. After the early cell divisions, however, each of the cells still possesses the potentiality for development into a perfect individual, and may do so if separated. Human identical twins are produced by the breaking apart of a single egg in the two-cell stage, or very soon after, and resemble each other closely because of their identical heredity. Ordinary twins develop from two wholly independent egg cells which merely happen to be fertilized at about the same time. Such twins resemble each other no more than ordinary brothers and sisters. These photomicrographs, of white rat eggs cells magnified 500 diameters, are by Dr. Joseph Long, of the University of California.

TWINS PROVE THE IMPORTANCE OF CHROMOSOMES

The Most Powerful of All Forces Operating to Control Human Destiny—"The Most Important Things in the Whole Known World"—Are So Small That a Microscope Is Required to See Them

Frederick Adams Woods

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WE KNOW at present that the chief, though probably not the sole, determiners of differences among higher animals lie in those infinitely important and complex microscopic granules known as chromosomes. The material out of which they are formed remains constant in every living cell, and they are visible and subject to numerical counting, at times of cell division. Most people have never heard of chromosomes. But they will if they live long enough; unless, perchance, some other word is introduced to take its place, for chromosomes are among the most important things, and, considering their size, they *are* the most important things in the whole known world. A generation from now the public will have heard of chromosomes just as today the public has heard of evolution and of bacteria. Chromosomes and heredity are in a way synonymous, but heredity is used in various senses by different people. When we say chromosomes, we speak of things tangible, or at least, if we cannot actually touch them, they are objects that can be seen and measured and counted.

Identical twins are among the most interesting of beings, because they alone have the same kind of chromosomes. This is due to the fact that very early in embryonic life there occurs an almost absolutely precise division of the chromosomes, so that two individuals are developed side by side, each controlled by similar determiners. The extreme resemblance of identical twins is itself a proof of the importance of these determiners (chromosomes), for otherwise we cannot explain all the phenomena.

It is known as a result of a great number of observations that children on the average resemble their fathers, and their father's family, quite as much as their mother's and their mother's family. The far-reaching significance of this every-day fact, like most wonders that are ever before our eyes, is apt to be overlooked. Even this fact alone is a proof of the extreme importance of chromosomes, since the egg is many hundred times as large as the sperm, but the chromosomes of the egg are no larger than those of the sperm. They are practically the same size, and presumably of corresponding chemical structure and importance.

Twins, then, are not needed to prove the extreme importance of chromosomes. What twins prove is this: They prove the lack of importance of environment, but only in one aspect and in one restricted meaning.

There is a great deal of loose talk about environment, all of which means nothing and gets nowhere. The only discussions that are today worth considering are those which are based upon quantitative measurements.

In a sense, environment is all-important, for without nourishment, oxygen, and warmth, growth is impossible; and without training, education, and social control, the development of the higher traits would not take place. But this environment is customary and expected. The question of practical interest is: How far do *changes* in the

NOT IDENTICAL TWINS MAY DIFFER IN RATE OF GROWTH AS WELL AS IN LOOKS

While it would be a mistake to overlook the influence of proper food upon the development of a child, it is just as great an error not to realize that children inherit different reactions with regard to the same foods. If one child develops more slowly than another, it may be because of its heredity and not because of any environmental influence. (Fig. 22.)

customary environment produce measureable modifications? In order to prove that a modification is due to an environmental change it is essential that the heredity (or chromosome) factor should be a constant. This requirement may be sometimes attained by using a large number of individuals whose average heredity may be reasonably supposed to be the same. For example, there cannot be any doubt but that the striking differences in the growth of dogs, sheep, and other animals, when given greater and smaller amounts of glandular extracts—thyroid, etc.—are really caused by these environmental forces; *i. e.*, a difference not caused by chromosome differences.

STRIKINGLY ALIKE IN OLD AGE

When these pictures were taken in 1915 these twins were about eighty years old. They had never been more than 10 months away from the village of Bethal, Maine, in all their lives. They invariably went for a walk every afternoon at about 4 o'clock, *always* accompanied by the two white cats. (Fig. 23.)

The great lesson derived from the records of identical twins is that the ordinary differences within the uterus of the mother and the ordinary differences within the home life and school life and even adult life are not of sufficient force to modify greatly the control of the chromosomes.

The non-identical or "fraternal" twins have the same chance to become similar through environmental action as the "identical," yet they are not so moulded. Photographs show this in the most obvious manner, and, if as appears from the records of the questionnaires, the resemblances are no greater in physical than in mental aspects, then the far-reaching inference is forced upon us that even mental and moral differences are controlled by forces lying in the primary chromosomes.

This does not mean that *great* changes in the environment may not cause considerable modification in the individual; but the point is that *great* changes are not usual. The very fact that they are great is associated with their scarcity, and under usual conditions of life the physical and mental differences that we commonly observe among our fellow-beings are really due to differences traceable in the chromosomes themselves.

A DEFINITION OF HEREDITY—"NATURE VS. NURTURE" NOT A GOOD EXPRESSION

Frederick Adams Woods

THE expression "Nature versus Nurture," introduced originally by Galton, has been very widely adopted, but this prettily balanced phrase is not altogether satisfactory from the standpoint of scientific definiteness. From the artistic point of view we cannot but admire a dainty little bit of word carpentry. We have the two N's furnishing alliteration, and the words nearly balance in weight. The last four letters are identical, and in addition to this the words seem to express well, the same idea as heredity vs. environment for the antithetical forces of nature. But here is already the first objection. The word nature can never be made to mean anything less than all the forces of the cosmos. Surely everything is nature.

Sometimes, again, the word nature is employed in another limited, yet entirely different sense, as meaning the wild-woods, the fields, the clouds, and the birds. The zealot advocates a "back to nature" movement, as though human nature were not a part of nature. In the same way our forefathers invented for us the phrase "natural history," thus suggesting that human history was unnatural or at least non-natural, and that man was apart from the world of organic life.

Of course this sort of criticism is almost inevitable, if we start to dissect the English language. The same objections can be raised against the words heredity and inheritance. We all use these words in different senses with different associative ideas, according to our age, habits of thought, and professional training, even if we are trying to use them in a narrowly defined and technical sense. The word heredity to a biologist, trained in microscopical anatomy and embryology, suggests a single cell—a germ-cell immediately after fertilization. Is it likely that this word suggests the same picture to a man trained in theology or law?

But we shall all have to see the same picture some time—that is, if we are to make the science of heredity part of the curriculum of education, and the best definition of heredity will have to be closely associated with the mechanism of chromosomes and germ-cells, and the clearest pictures will be mentally held only by those who have some ideas of the structures and functionings of these primordial elements.

The use of the word "nature" as synonymous with heredity is associated with an objection beyond the academic one that everything is nature anyway; and that is, because we have the common phrase "human nature," so that when we say the *nature* of that man is bad, we do not know whether we mean to suggest that his bad nature is inherent or the result of bad associates.

Again, we have the familiar phrase applied to kindly souls that he or she has a "good nature." This last idea can only be conveyed if the words are spoken (or read as spoken) quickly. How different is the picture portrayed of one who has a good nature (spoken

NOTE: In connection with this discussion it may interest some readers to refer to a former article in the JOURNAL OF HEREDITY for February, 1918 (vol. ix, No. 2) on the "Meanings of Genetic Terms." About sixty of the terms commonly used in the subject of genetics are there discussed.—Ed.

quickly) from one who has (accent on the good) a *good* nature. So we may have good-natured people who may be lazy, dirty, and incompetent. It is only by stressing the last word that we can convey in good *nature* anything of the Galtonian usage of the word.

The word heredity is also far from ideal as an expression of scientific exactitude. In the first place, we have our "social heredity" or even our "heredity from God," though these usages are usually pretty clearly differentiated, and it is evident from the text that we are talking about something other than the functioning of reproductive germ-cells. The chief difficulty in using the word heredity is that to many people heredity either means all that one is at birth, or means all that one has for an ancestry. Neither of these conceptions is in accordance with modern views on the method of reproductive generation and therefore it is undesirable to use the word heredity in either of these senses.

All that one is at birth is already a compound resultant of germ-plasm and environment. All that one has for an ancestry may amount to little. It is solely a question of how the ancestral germ-plasms are sorted and arranged in any particular case.

The word "heredity" should be understood to signify all that is contained in the original fertilized cell (zygote) from which all the subsequent cells are, by cell-division, produced. If the chromosomes are found to be the sole intracellular agencies controlling the normal development of the body, then the word "heredity" may be considered as synonymous with chromosomes, and to say a man has a good heredity is to say he has good chromosomes. If, as is more probable, other portions of the cell enter somewhat into the matter, though to a limited extent, then the word "heredity" is almost, though not quite, an equivalent of the word chromosomes.

OF THE SAME HEREDITY

George and John Seiffert, of York, Pa., eighteen years old. (Fig. 24.)

IDENTICAL TWINS FROM JAPAN, YEIICHI AND YUJI OGATA, OF TOKIO

(Fig. 25)

THEY LOOK THE SAME, THOUGH ONE DRINKS FASTER THAN THE OTHER

(Fig. 26.)

ARE THESE BOYS IDENTICAL?

Appearing at slightly different angles, it is hard to tell if these boys are identical twins and the Association has no data about them at present. They are sons of B. E. Burdick, of Racine, Wis. (Fig. 27.)

TWO SPANISH BOYS FROM CUBA

From Cuba have come the pictures of Enrique and Armando Brana. These twins were born in June, 1912. (Fig. 28.)

STRIKINGLY SIMILAR IN CHARACTER

The Zermansky twins have a similar love of poetry and music, enjoy the same sports, but differ in their taste for mathematics. Philip dislikes all mathematics except trigonometry, while Mark has been good in all mathematics. They both have slight eye trouble, and their gait is different. Mark was left-handed as a child but was taught to use his right hand. Their writing is strikingly alike; both have a "double-jointed" thumb on the left hand. Mark works hard at anything and does well on examinations, while Philip is inclined to work only at what interests him, and he does not do his best on examinations as he is apt to be nervous. (Fig. 29.)

THE BROWN TWINS AT FIFTY-NINE YEARS AND THE HARLOW TWINS AT TEN MONTHS

For fifty-nine years the brothers (top), whose hair is now snow white, have been taken for one another. Edwin is a Congregational minister and has lived in various places, and Edgar a bookkeeper who has stayed in Maine. Both were born with defective eyesight, one in the right, and the other in the left eye. Both are right-handed; for years with similar gait, with tastes remarkably similar, with similar bodily weaknesses, one requiring surgical aid, both with idiosyncrasy against strawberries and acid foods, both with a good sense of locality and direction, and both peculiarly congenial towards each other. Their handwriting is not strikingly similar. Edgar L., 3 Holyoke St., Brewer, Me. (right); Edwin C., Island Falls, Me. (left).

The chances are very great that, like the Brown twins, the Harlows (bottom picture) will remain alike through life. (Fig. 30.)